MICHIGAN ACADEMY OF SCIENCE ARTS AND LETTERS

VOLUME XXIV (1938)

PART I: BOTANY AND FORESTRY

VOLUME XXIV CONSISTS OF FOUR PARTS:

PART I: BOTANY AND FORESTRY
PART II: ZOÖLOGY
PART III: GEOGRAPHY
PART IV: GENERAL SECTION
Anthropology, Geology
Language and Literature
Psychology

PAPERS OF THE MICHIGAN ACADEMY OF SCIENCE ARTS AND LETTERS

EDITORS

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VOLUME XXIV (1938)

PART I: BOTANY AND FORESTRY

"Pusilla res mundus est nisi in illo
quod quaerat omnis mundus habeat."
— SENECA, *Naturales Quaestiones*

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PLANTS NEW OR RARE IN MICHIGAN RECORDS

CLARENCE R. HANES

PREVIOUS to 1938 two reports[1] had been made of plants collected by the writer which were new or rare in Michigan records. The present paper treats of a number of additions, most of which were made in 1937.

In all these reports the collections were made in Kalamazoo County. If intensive study of Kalamazoo County for several years has furnished so many new or infrequent species, may there not be similar discoveries in other counties of our state when interest shall have been aroused to make a thorough study of the entire flora of Michigan?

Those species are cited that have never been reported for the state or that have been reported as occurring in one or two locations only. In both these groups are some plants that show an extension of range. This phase will be treated more fully under the names of species. Where no mention is made of the collector, the collections cited were those of Mrs. Florence N. Hanes and the writer.

The determination of the plants has been confirmed at the Arnold Arboretum or at the New York Botanical Garden and by F. J. Hermann, of the University of Michigan, or by Mrs. Agnes Chase, of the Bureau of Plant Industry.

Names of species which apparently have not previously been reported from Michigan are indicated by an asterisk.

LIST OF SPECIES

NAJAS GRACILLIMA (A. Br.) Morong. — South shore of Eagle Lake, Texas Township, Aug. 31, 1937.

This is the second recent collection of this species in Michigan.

[1] Hermann, F. J., "Notes on the Flora of Michigan. I," *Rhodora*, 38: 362 367. 1936; Hanes, C. R., "Additions to the Flora of Michigan," *Pap. Mich. Acad. Sci., Arts, and Letters*, 23 (1937): 135-139. 1938.

In 1936 it was found by F. J. Hermann in a small lake just outside Ann Arbor, in Washtenaw County.

MUHLENBERGIA RICHARDSONIS (Trin.) Rydb. (*Sporobolus Richardsonis* of *Gray's Manual*, Seventh Edition). — West side of Section 24, Alamo Township, Aug. 26, 1937.

Between Maine in the east and the Dakotas in the west, Michigan is the only state from which this grass has previously been reported. Farwell [2] collected it in Livingston County several years ago.

The plateau form of the grass is only two to six inches tall, whereas that of Michigan is very slender and reaches a height of twenty-four inches or more. It is especially luxuriant around old ant hills, where it forms clumps two feet across.

Some of its associates are *Solidago ohioensis, Tofieldia glutinosa, Berula erecta, Rynchospora capillacea,* and *Cacalia tuberosa.*

*PANICUM CALLIPHYLLUM Ashe. — Oak-hickory woods in Section 19, Richland Township, Aug. 5, 1937.

In Hitchcock's *Manual* this grass is given as rare and local. At the station mentioned above it was quite plentiful.

*CAREX LEAVENWORTHII Dewey. — In gravelly sandy loam, four miles north of Kalamazoo, June 8, 1937.

The locality where this species was collected is known as Cooper's Glen. It is interesting to note that *Carex cephalophora,* a sedge that closely resembles *C. Leavenworthii,* was here associated with it.

C. Leavenworthii probably reaches the northern limit of its range in the locality where it was found, which is only four miles south of Allegan County.

*CAREX RICHII (Fernald) Mack. (*C. hormathodes* var. *Richii* of *Gray's Manual,* Seventh Edition). — In a swamp two miles north of Vicksburg, June 19, 1937.

Growing to a height of two or more feet, this sedge forms large dense clumps.

*CAREX LONGII Mack. (*C. albolutescens* of *Gray's Manual,* Seventh Edition). — East of Sugarloaf Lake, June 8, 1933; two miles north of Vicksburg in peaty woods, July 2, 1937; one-half mile northeast of Goose Lake, in a dry oak woodland near swamp, July 17, 1937.

[2] Farwell, O. A., "Botanical Gleanings in Michigan. VI," *Am. Mid. Nat.,* 12: 117. 1930.

This species, like the last and that next following, belongs primarily to the Atlantic Coastal Plain. Inland the three are rather infrequent.

CAREX ANNECTENS Bicknell. — In a swamp two miles north of Vicksburg, July 10, 1937, F. J. Hermann.

This sedge was found in almost the same place as *C. Richii*, only in slightly drier soil. This is the second collection of *C. annectens* made in Michigan by F. J. Hermann. The first was made in Washtenaw County in 1936.

CAREX PROJECTA Mack. — Two miles southwest of Fulton in moist woods along creek, July 22, 1937.

This station is only one and one-half miles from the boundary between Kalamazoo and St. Joseph counties. It must be very near the southern limit of the range of the species.

JUNCUS SCIRPOIDES Lam. — East shore of Austin Lake, July 30, 1937, F. J. Hermann.

This is primarily an Atlantic Coastal Plain species, but on the dunes at Austin Lake it is very abundant. Another Coastal Plain species, *Juncus Greenei*, is associated with it.

Dr. Beal [3] cites F. P. Daniels as having found it at Sturgis, Michigan.

JUNCUS BIFLORUS Ell. (*J. aristulatus* of *Gray's Manual*, Seventh Edition). — Border of Vicksburg Creek south of Vicksburg, July 15, 1936, F. W. Rapp.

One previous collection of this *Juncus* has been made in Michigan. Dr. Beal [4] credits O. A. Farwell with finding *Juncus marginatus "aristatus"* (Michx.) Coville in Detroit.

POGONIA TRIANTHOPHORA (Sw.) BSP. — In a beech woods in the western part of Texas Township, Sept. 4, 1937.

Several authors have regarded this orchid as the rarest in Michigan and Wisconsin. No recent reports have been made for our state, and specimens in herbaria are very rare.

Beech, sugar maple, shagbark hickory, ash, and white elm were the predominate forest trees. *Gnaphalium purpureum*, *Aster cordifolius*, and *Eupatorium fistulosum* were also associated with it.

The orchids grew in a slight hollow filled with leaves. There

[3] Beal, W. J., "Michigan Flora," *Annual Rep. Mich. Acad. Sci.*, 5 : 60. 1904.

[4] *Idem*, "Additions to the Michigan Flora," *ibid.*, 10 : 87. 1908.

were several together, so that it was difficult to remove them without dislodging all. Luckily one or two were undisturbed. An intensive search of the woods failed to reveal any other colonies. Since they rise only three or four inches above the leaves in which they grow, it is not at all unlikely that this rare species may be frequently overlooked, especially when not in flower.

*BETULA PURPUSII Schneider. — Swamp in Section 24, Texas Township; catkins April 26, 1937, leaves June 12, 1937.

Specimens of catkins and leaves of this birch sent to the Arnold Arboretum compared very closely with material from Minnesota. From the surroundings, however, it would appear that *Betula pumila* rather than *B. pumila* var. *glandulifera* was one parent of the cross.

STELLARIA BOREALIS Bigel. — Creek one mile southeast of Alamo, Sept. 19, 1936.

This is mainly a species of Canada and the northern boundary of the United States. Apparently this report extends its southern range in Michigan. Observation at different seasons in 1937 failed to reveal any blossoming period. This may have been due to the high water in creeks and lakes during June and July of that year.

ERUCASTRUM GALLICUM (Willd.) Schulz. — One mile west of Schoolcraft along the Grand Trunk Railway, Sept. 14, 1936; one and one-half miles east of Schoolcraft on this same railway, Sept. 14, 1937.

Fred W. Rapp of Vicksburg also collected this plant in 1937 along the Pennsylvania Railroad lines near Vicksburg. Walpole [5] reports the species for Washtenaw County.

ERYSIMUM REPANDUM L. — One-half mile west of Schoolcraft on the right of way of the Grand Trunk Railway, May 14, 1937.

Only a few plants were found. Farwell [6] reports this species from La Salle, and Walpole [7] lists it from St. Clair and Monroe counties.

ERYSIMUM ASPERUM DC. — Four miles east of Schoolcraft along the Grand Trunk Railway, May 26, 1937.

[5] Walpole, B. A., *Flora of Washtenaw County*, p. 43. 1924.

[6] Farwell, O. A., "Notes on the Michigan Flora. Part V," *Pap. Mich. Acad. Sci., Arts, and Letters*, 2 (1922) : 24. 1923.

[7] Walpole, B. A., "Distribution of the Cruciferae in Michigan," *Pap. Mich. Acad. Sci., Arts, and Letters*, 6 (1926) : 327. 1927.

Several plants were growing in the railroad ballast. Reported from Kent County by Walpole.[8]

PENSTEMON PALLIDUS Small. — Sandy soil east of Sugarloaf Lake on U. S. Highway 131, June 8, 1933.

Beal, in "Michigan Flora," [9] lists *Pentstemon canescens* Britton as having been collected in Detroit by O. A. Farwell, and Pennell [10] cites a collection from Washtenaw County by J. H. Ehlers and one from Wayne County by C. Billington.

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[8] *Ibid.*, p. 328.

[9] P. 119 of article cited in note 3.

[10] Pennell, F. W., *The Scrophulariaceae of Eastern Temperate North America*, p. 225. Monograph I, Acad. Nat. Sci. of Phila., 1935.

LICHENS FROM BRITISH HONDURAS COLLECTED BY E. B. MAINS *

JOYCE HEDRICK

THE specimens upon which this list of forty-one species and eight subspecies is based were collected by Professor E. B. Mains in the El Cayo District of British Honduras during June, July, and August of 1936.[1] Collections were made in two distinct regions: in the vicinity of Valentin, a limestone area, and in the Mountain Pine Ridge, an acid granite area. The latter is burned over each year, and lichen specimens are not plentiful.

Little has been published on the lichen flora of British Honduras. In a recent paper [2] fourteen species and three subspecies are listed. The species reported here are mainly limited to the tropics, some are to be found in tropical and subtropical regions, a few are cosmopolitan, and others are restricted to definite localities. Many collections are on leaves, and among these are the three species which are here reported as new. The photographs were made by Professor Mains.

List of Species

PYRENULA NITIDA (Weig.) Ach. — On upper branches of tree, Valentin, 3761. This species is cosmopolitan.

PHYLLOPORINA EPIPHYLLA (Fée) Müll. Arg. — On leaves, Valentin, 3559, 3561, 3602, 3612, 3613, 3638, 3651, 3679, 3756; Cohune Ridge, 3816. Very common, growing on the upper side of leaves. The fruits are tiny black perithecia containing hyaline eight-celled spores. It is common throughout the tropics.

PHYLLOPORINA PHYLLOGENA Müll. Arg. — On leaves, Cohune Ridge, 3816a. The species has been reported from several localities in the American tropics.

* Papers from the Herbarium of the University of Michigan.

[1] The expedition was partly supported by funds from the Horace H. Rackham School of Graduate Studies of the University of Michigan.

[2] Hedrick, Joyce, "Lichens from the Yucatan Peninsula," *Botany of the Maya Area, Misc. Papers*, Carnegie Inst. Washington, Publ. 461: 107 114. 1935.

PHYLLOPORINA RUFULA (Kremphl.) Vainio. — On leaves, Valentin, 3640, 3679c. Distinguished from the two species above by the reddish brown perithecia; can be found throughout the tropics.

STRIGULA ARGYRONEMA Müll. Arg. — On leaves, El Cayo, 3534a; San Agustin, 3988a. It has been reported only from Cuba and Surinam.

STRIGULA COMPLANATA (Fée) Nyl. — On leaves, Valentin, 3561a; Cohune Ridge, 3811. Very common throughout the tropics and often extending into subtropical regions.

STRIGULA ELEGANS (Fée) Müll. Arg. — On leaves, Valentin, 3615. Pl. I, Fig. 1. The species has been reported as common in the tropics.

PYRGILLUS JAVANICUS Nyl. — On trunk of fallen tree, Valentin, 3652. An inconspicuous lichen growing on old wood. The thallus appears as discolored areas of the substratum. The apothecia are very small, black, more or less closely adnate. The spores are in a dense black mass, since the asci disintegrate before the spores are mature, a characteristic of the families in the group Coniocarpineae. It has been reported from Java, Australia, and southern United States.

OPEGRAPHA PROSODEA Ach. — On bark of Hyperbena, along the Belize River, 3535a. This species varies greatly. The material placed here shows elongated, curved, narrow apothecia which contain spores 9–11-septate, and measuring 64.5–78 × 11 μ. It is common throughout the tropics.

Arthoniopsis belizensis, sp. nov. — Thallus tenuissimus, laevigatus, glaucescens, saepe inconspicuus et interdum evanescens; apothecia minuta vel parva, 0.1–0.5 mm. lata, rotunda vel leviter irregularia, adnata, dispersa vel rare aggregata, disco plano, fuscenti-nigro vel nigro; sporae 8, 6–8 × 3–4 μ, hyalinae, soleaformes, 1-septatae, uno loculo maiore.

Thallus very thin, smooth, greenish gray, often inconspicuous and sometimes disappearing; apothecia minute to small, 0.1–0.5 mm. across, round to slightly irregular, closely adnate, scattered or rarely clustered, the disc flat, brownish black to black; hypothecium hyaline to tinged with brown; hymenium hyaline; paraphyses branched and interwoven, usually short; asci clavate to broadly clavate, the apical wall somewhat thickened; spores 8, 6–8 × 3–4 μ, hyaline, soleiform, 1-septate, one cell larger.

The algal host is Phyllactidium.

On leaves of palm, El Cayo District, Valentin, E. B. Mains 3651b, June 27, 1936. The presence of Phyllactidium as the algal host separates Arthoniopsis from Arthonia. It could as well be separated by the difference in substratum. Species of Arthoniopsis are limited to leaves and have been reported only from tropical and subtropical regions. *A. belizensis* is similar to *A. aciniformis* (Stirt.) Müll. Arg. from Brazil, to *A. leptosperma* Müll. Arg. from Brazil, and to *A. microsticta* Vainio from Dominica, for it has the small spores of *A. leptosperma* and the smaller apothecia of the other two species. Pl. I, Fig. 2.

FOURGEA FILICINA (Mont.) Trevis. — On leaves, Valentin, 3651a, 3756b. It has been reported from several localities in the American tropics.

CHIODECTON NIGROCINCTUM (Ehrh.) Mont. — On bark of living tree, Valentin, 3723. A more or less conspicuous lichen, often covering large areas with a thin grayish white to pinkish layer bearing numerous black dots, which are the tiny, narrowly opened discs of the apothecia. It is not uncommon throughout the tropics.

CHIODECTON SANGUINEUM (Swartz) Vainio. — On upper branches of tree, San Agustin, 3955a. Distinguished from the species above by the distinct reddish color of the thallus, and found more commonly throughout the tropics and the subtropics.

BYSSOLOMA TRICHOLOMUM (Mont.) Zahlbr. — On leaves, Valentin, 3679b. This species is reported from temperate and tropical regions.

OCELLULARIA OLIVACEA (Fée) Müll. Arg. — On bark of fallen tree, Valentin, 3636. The thallus is smooth to somewhat rough, thin, and olive-colored. The apothecia are numerous, very small, rarely more than 0.2 mm. across, immersed, with concave, brownish disc and a thin light-colored interior exciple. The spores are 3-septate, hyaline, eight in each ascus. It has been reported from tropical America.

LEPTOTREMA GLAUCESCENS (Nyl.) Müll. Arg. — Forming crusts on the surface of soil in highland, Vaquero, 4113. The apothecia are immersed and bordered by a very thin light-colored exciple, but later become almost superficial, and the interior exciple is surrounded by a heavy uneven thalloid one. The species is not uncommon throughout tropical regions.

PHYLLOPHTHALMARIA COCCINEA (Müll. Arg.) Zahlbr. — On leaves, Valentin, 3679c; San Agustin, 3988. A very tiny yet conspicuous lichen. The thallus is extremely thin, greenish gray, and can easily be peeled from the leaf substratum. The minute apothecia are scarlet. It is limited to the tropics.

SPOROPODIUM PHYLLOCHARIS (Mont.) Mass. — On leaves, Cohune Ridge, 3792a; San Agustin, 3917. A small but rather conspicuous lichen, more or less covering the upper side of leaves, with small scattered areas of grayish white thallus bearing numerous brownish black apothecia. The species is common throughout the tropics.

Sporopodium tropicum, sp. nov. — Thallus tenuis vel tenuissimus, interdum evanescens, cinereo-glaucescens, laevigatus vel leviter inaequalis, maculas irregulares formans; apothecia parva, 0.3 1 mm. lata, adnata vel subsessilia, rotunda, dispersa, disco concavo vel plano, fuscescente vel rare nigro, margine crasso, integro, prominente, thallo concolore; sporae 1-4, 72-80 × 8 11 μ, hyalinae, longe ellipsoideae, interdum curvatae, transverse 29-septatae et longitudinaliter 1-2-septatae, loculis irregularibus.

Thallus thin to very thin, sometimes disappearing, ashy gray, smooth to slightly rough, in irregular areas; apothecia small, 0.3-1 mm. across, adnate to subsessile, round, scattered, the disc concave to flat, brownish to brown or black, the exciple thick, entire, prominent, colored like the thallus; hypothecium tinged brownish; hymenium hyaline; paraphyses branched and interwoven; asci long-clavate; spores 1 4, 72-80 × 8 11 μ, hyaline, long-ellipsoid, sometimes curved, 29-septate transversely and 1 2-septate longitudinally, the cells irregular.

The algal host is Protococcus.

On leaves of Hyperbena (?) along the Belize River, El Cayo District, El Cayo, E. B. Mains 3534, June 17, 1936. This species has a very distinct thalloid exciple, which may cause it to be placed elsewhere. It is distinguished from other species of Sporopodium by the brownish apothecia and the narrow spores, which are usually 2-4 in each ascus. Pl. II, Fig. 1.

TRICHARIA MACROSPORA Hedrick. — On leaves, Valentin, 3552, 3679a. It has been reported from Yucatan.

CALENIA DISPERSA Hedrick. — On leaves, Cohune Ridge, 3773a. This species was reported from Yucatan.

Calenia yucatanensis, sp. nov. – Thallus tenuis vel tenuissimus, maculas parvas rotundas formans, laevigatus vel demum leviter inaequalis, cinereo- vel albido-glaucescens; apothecia minuta, 0.1–0.4 mm. lata, rotunda, primum immersa, dein emergentia et adnata, disco plano, nigro vel rare albido-pruinoso, margine tenui, integro, prominente, thallo concolore; sporae 6–8, 22–26 × 4.5–5 μ, hyalinae, fusiformes, interdum curvatae, 3-septatae, loculis cylindricis, uno centrali loculo maiore.

Thallus thin to very thin, forming small circular areas, smooth to slightly rough, ashy to whitish gray; apothecia minute, 0.1–0.4 mm. across, round, immersed to superficial and adnate, the disc flat, black or rarely whitish pruinose, the exciple thin, entire, prominent, colored like the thallus; hypothecium hyaline to tinged pale brownish; hymenium hyaline; paraphyses branched especially above and somewhat interwoven; ascus clavate; spores 6–8, 22–26 × 4.5–5 μ, hyaline, fusiform, sometimes curved, 3-septate, the cells cylindrical and one central cell larger.

The algal host is Protococcus.

On leaves of palms, El Cayo District, San Agustin, E. B. Mains 4134, August 13, 1936; and on leaves of Brosimum, El Cayo District, Valentin, E. B. Mains 3756a, July 7, 1936. The 3-septate spores place the species close to *C. consimilis* Müll. Arg., *C. pulchella* Müll. Arg., and *C. trisептata* Zahlbr., but in none of these are the spores more than 16 μ in length. Other species with spores more than 20 μ have 5–17 septa. Pl. II, Fig. 2.

COENOGONIUM LEPRIEURII (Mont.) Nyl. On trunk of palm, Valentin, 3556. This species is rather common throughout the tropics.

SYNECHOBLASTUS NIGRESCENS (Huds.) Trevis. — On branches of Heliocarpus, Chalillo Crossing, 3847. It is cosmopolitan in range.

LEPTOGIUM BULLATUM (Swartz) Mont. On Heliocarpus, Chalillo Crossing, 3848. This species has been reported from tropical and subtropical regions.

LEPTOGIUM LICHENOIDES (L.) Zahlbr. — On granite, San Agustin, 3961. This is a cosmopolitan species.

LEPTOGIUM TREMELLOIDES (L.) S. F. Gray. — On rotten wood, Valentin, 3718; San Agustin, 3987. This species is very common and is widely distributed.

LEPTOGIUM TREMELLOIDES var. AZUREUM (Swartz) Nyl. — On upper

branches of tree, Valentin, 3759; on granite, San Agustin, 3934. The variety, also, is common and widely distributed.

PANNARIA MARIANA (E. Fries) Müll. Arg. — On upper branches of tree, San Agustin, 3956; on base of tree near stream, Vaquero, 4102. The specimen from San Agustin is fruited, showing the typical apothecia with reddish brown discs and thalloid exciple. The material from Vaquero is sterile. Both collections show the thin grayish brown to brown thallus bordered by a thick black fringe of hypothallus. Reported from the tropics.

PANNARIA MARIANA f. ISIDIOIDEA Müll. Arg. — On upper branches of tree, San Agustin, 3956a. The form is separated from the species above only by the numerous minute coralloid branchlets which more or less cover the sterile thallus. Previously reported (*op. cit.*, p. 112) as *Coccocarpia pellita* var. *luridorufa.* It has been found on the Mariana Islands.

COCCOCARPIA CRONIA (Tuck.) Vainio. — On granite, San Agustin, 3891, 3966. This species is to be found in tropical regions.

COCCOCARPIA PELLITA (Ach.) Müll. Arg. — On branches of fallen tree, Valentin, 3565. It is limited to the tropics.

STICTA AURATA Ach. — On upper branches of tree, Cohune Ridge, 3789. The species has been reported from tropical and subtropical regions.

STICTA QUERCIZANS Ach. — On branches of trees, Valentin, 3656; San Agustin, 3955. Also rather common in the tropics and subtropics.

PHYLLOPSORA PARVIFLORA (Pers.) Müll. Arg. — On upper branches of tree, Valentin, 3760. It is not uncommon in tropical regions.

PHYLLOPSORA PARVIFLORA var. FIBRILLIFERA (Nyl.) Müll. Arg. — On trunk of tree, Valentin, 3653. The variety, also, is limited to the tropics.

CLADONIA DIDYMA (Fée) Vainio. — On rotting log, bank of Rio Frio, San Agustin, 4013. This species is to be found in temperate and subtropical regions, rarely extending into the tropics.

CLADONIA DIDYMA var. MUSCIGENA (Eschw.) Vainio. — On rotting log, Cohune Ridge, 3833. The variety is reported from tropical and subtropical regions.

CLADONIA FIMBRIATA var. SIMPLEX (Weis.) Flot. — On granite beside stream, San Agustin, 3931. The range of this variety is cosmopolitan.

CLADONIA MITRULA Tuck. — On granite, San Agustin, 3892. The species is common throughout temperate and subtropical America.

CLADONIA VERTICILLATA var. EVOLUTA T. Fries. — On granite, San Agustin, 3964. This variety is cosmopolitan.

PARMELIA CRISTIFERA Tayl. — On trunk of tree, Cohune Ridge, 3826; on granite, San Agustin, 3965; on branches of pine, San Agustin, 4098. It is to be found throughout the tropics.

PARMELIA LATISSIMA Fée. — On bark of tree, Cohune Ridge, 3828. This and the preceding species form a very conspicuous part of the lichen flora of the tropics. The thalli vary greatly in size, are light-colored above and brown to black below, and are loosely attached to the substratum. Specimens of both species are rarely fruited, but can readily be distinguished by the coralloid branchlets or the dense masses of soredia.

USNEA FLORIDA (L.) Wigg. — On log, Cohune Ridge, 3793; on branches of pine, San Agustin, 3960. This is a cosmopolitan species.

USNEA FLORIDA var. RUBIGINEA Michx. — On branches of pine, San Agustin, 3890. The variety is based on the reddish color of the much-branched thalli. It is widely distributed.

USNEA FLORIDA var. STRIGOSA Ach. — On branches of pine, San Agustin, 3890a. This is a short stiffly branched variety of the species, usually densely covered with minute fibrils. It is to be found wherever the species is reported.

BOMBYIOSPORA DOMINGENSIS (Pers.) Zahlbr. — On bark of tree along Belize River, 3535; Valentin, 3551, 3722; Cohune Ridge, 3784. This species is very common throughout tropical regions.

ANAPTYCHIA SPECIOSA (Wulf.) Mass. — On granite beside stream, San Agustin, 3930. It is widely distributed.

CORA PAVONIA (Swartz) E. Fries. — On granite, San Agustin, 3963. The one lichen in this list belonging under Hymeno-lichens. It is limited to tropical regions.

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PLATES I–II

FIG. 1 *Strigula elegans* (Fée) Mull. Arg. Part of a leaf showing several patches of thallus which are more or less covered with tiny black apothecia. × 12

FIG. 2. *Arthoniopsis belizensis*, sp. nov. Part of a leaf showing many round to irregular apothecia. × 12

FIG 1. *Sporopodium tropicum*, sp nov Part of a leaf showing the roughened thallus and the apothecia, which are adnate to subsessile and have a thick prominent exciple. × 12

FIG. 2. *Calenia yucatanensis*, sp. nov. Part of a leaf showing the thin thallus, through which numerous small apothecia have emerged. × 12

ADDITIONS TO THE FLORA OF WASHTENAW COUNTY, MICHIGAN. III *

FREDERICK J. HERMANN

COLLECTIONS made by the writer during the seasons of 1936 and 1937 have resulted in the addition of the following vascular plants to the known flora of Washtenaw County.[1] The specimens upon which the records are based have been deposited in the Herbarium of the University of Michigan and in the writer's herbarium.

List of Species

BOTRYCHIUM MULTIFIDUM (Gmelin) Rupr. — Low maple woods near shore of Third Sister Lake, 3 miles west of Ann Arbor, *8356*.

THUJA OCCIDENTALIS L. — Plentiful in tamarack yellow birch bog bordering small lake, Section 31, Dexter Township, $2\frac{1}{4}$ miles northeast of Chelsea, *9256*.

NAIAS GRACILLIMA (A Br.) Morong. — In shallow water near shore of Third Sister Lake, 3 miles west of Ann Arbor, *8374*. The first known locality for this species in Michigan.

POTAMOGETON AMERICANUS C. & S. — In water four feet deep, Huron River (the Overflow), $3\frac{1}{2}$ miles southeast of Ann Arbor, *9383*.

POTAMOGETON ANGUSTIFOLIUS Berch. & Presl. — In water two feet deep, Cassidy Lake, $3\frac{3}{4}$ miles northwest of Chelsea, *9294*.

POTAMOGETON ZOSTERIFORMIS Fernald. — In water four feet deep, Huron River (the Overflow), $3\frac{1}{2}$ miles southeast of Ann Arbor, *9382*.

ALISMA PLANTAGO-AQUATICA L. var. BREVIPES (Greene) Sam. — Occasional; much less common than *A. subcordatum*. Marshy bank of Huron River, $2\frac{1}{4}$ miles east of Ann Arbor, *9113*.

ARISTIDA PURPURASCENS Poir. - Low sandy hills, Section 31, Lyn-

* Papers from the Department of Botany of the University of Michigan, No. 654.

[1] Previous reports were published in *Pap. Mich. Acad. Sci., Arts, and Letters*, 21 (1935): 81–87. 1936, and 22 (1936): 91–94. 1937.

don Township, 6¾ miles northwest of Chelsea, *8332;* low sandy field, Section 31, Dexter Township, 2½ miles northeast of Chelsea, *9262.*

ELEUSINE INDICA Gaertn. — Lawn extension on East University Avenue, east of West Engineering Building, University of Michigan campus, Ann Arbor, *8395.*

ERAGROSTIS PILOSA (L.) Beauv. — Lawn extension, corner of State and Monroe streets, Ann Arbor, *9222.* Determination confirmed by Agnes Chase. *E. pilosa* of Walpole's *Flora of Washtenaw County* is *E. pectinacea* (Michx.) Nees.

MUHLENBERGIA MEXICANA (L.) Trin. f. COMMUTATA (Scribn.) Wieg. — Shaded roadside bordering Huron River, Nichols Arboretum, Ann Arbor, *9216.*

MUHLENBERGIA TENUIFLORA (Willd.) BSP. — Moist maple–ironwood terrace of Huron River, Cedar Bend, 1 mile northeast of Ann Arbor, *9281;* moist steep calcareous bank of stream, Cascade Glen, 1½ miles northwest of Ann Arbor, *9353.*

PANICUM CAPILLARE L. var. OCCIDENTALE Rydb. — Low marshy meadow near Dexter Park, 1¼ miles east of Dexter, *9148.*

PASPALUM PUBESCENS Muhl. — Plentiful in sandy fallow field, Kleinschmidt Farm, Section 8, York Township, 2 miles southeast of Saline, *9172.*

POA SYLVESTRIS Gray. — Rich oak–maple woods, Section 16, Pittsfield Township, 4½ miles southeast of Ann Arbor, *6789.*

SPOROBOLUS ASPER (Michx.) Kunth. — Cinder railroad siding, 2¼ miles east of Ann Arbor, *9367.*

TRIODIA FLAVA (L.) Smyth. — Plentiful in dry sandy clearing southeast of Crooked Lake, Section 8, Sylvan Township, 4¾ miles west of Chelsea, *9345.*

CAREX ANNECTENS Bickn. — Marshy meadow, Section 16, Webster Township, 3½ miles northeast of Dexter, *8832, 9097.* Not previously reported from Michigan.

CAREX CANESCENS L. var. SUBLOLIACEA Laestad. — Swampy maple woods on Milford Road, Section 7, Salem Township, 3¼ miles west of Salem, *7414.* A more northern variety than the common var. *disjuncta.*

CAREX LAXICULMIS Schwein. — Open oak–hickory slope, Nichols Arboretum, Ann Arbor, *7449.*

CAREX MOLESTA Mack. — Grassy oak–hickory woods on north bank

of Huron River, Section 28, Ann Arbor Township, $1\frac{1}{4}$ miles east of Ann Arbor, *9107*.

CAREX MUHLENBERGII Schkuhr. var. ENERVIS Boott. (*C. plana* Mack.). — Abundant on sandy hills, Section 31, Lyndon Township, $6\frac{3}{4}$ miles northwest of Chelsea, *7454*.

CAREX PRAIREA Dewey. — Marsh south of Cavanaugh Lake, *6221;* marshy bank of Huron River, Cascade Glen, 3 miles northwest of Ann Arbor, *7445*.

CAREX TENERA Dewey. — Low grassy edge of woods on Milford Road, Section 36, Northfield Township, $3\frac{1}{4}$ miles northwest of Dixboro, *7396*.

CAREX TRICHOCARPA Muhl. — Abundant in ditch bordering railroad and on steep bank of Huron River, $2\frac{1}{4}$ miles east of Ann Arbor, *9188*.

CYPERUS ESCULENTUS L. — Plentiful in low fallow field near the Island, 1 mile northeast of Ann Arbor, *9170*.

CYPERUS FERRUGINESCENS Boeckl. — Open mucky shore of Third Sister Lake, 3 miles west of Ann Arbor, *8371*.

ELEOCHARIS PAUCIFLORA (Lightf.) Link. var. FERNALDII Svenson. — Marly shore of Cassidy Lake, $3\frac{3}{4}$ miles northwest of Chelsea, *9347*.

ELEOCHARIS ROSTELLATA Torr. — Marly shore of Cassidy Lake, $3\frac{3}{4}$ miles northwest of Chelsea, *9321*.

RHYNCHOSPORA GLOMERATA (L.) Vahl var. MINOR Britton. — Marshy border of tamarack bog, Section 31, Dexter Township, $2\frac{1}{4}$ miles northeast of Chelsea, *9247*.

SCIRPUS ATROVIRENS Muhl. f. PROLIFERUS Hermann. — Marshy edge of low woods, Cady's Corner, Section 22, Pittsfield Township, 5 miles southwest of Ypsilanti, *8402*.

SCIRPUS ATROVIRENS Muhl. var. GEORGIANUS (Harper) Fernald. — Border of pond in low woods, Section 32, Northfield Township, $5\frac{1}{4}$ miles north of Ann Arbor, *9267*.

SCIRPUS ATROVIRENS Muhl. var. GEORGIANUS (Harper) Fernald f. VIVIPARUS Victorin. — Border of pond in low woods, Section 32, Northfield Township, $5\frac{1}{4}$ miles north of Ann Arbor, *9266*.

SCLERIA VERTICILLATA Muhl. — Marly edge of Cassidy Lake, $3\frac{3}{4}$ miles northwest of Chelsea, *9323*.

POPULUS DELTOIDES Marsh. — Frequent. Bank of Huron River, Nichols Arboretum, Ann Arbor, *8605*.

SALIX DISCOLOR Muhl. var. ERIOCEPHALA (Michx.) Anders. — Steep railroad embankment, 2¼ miles east of Ann Arbor, *9193*.

SALIX HUMILIS Marsh. — Roadside thicket, Section 1, Northfield Township, *8577½*.

CARPINUS CAROLINIANA Walt. var. VIRGINIANA (Marsh.) Fernald. — Bank of Huron River, Nichols Arboretum, Ann Arbor, *8604*. Typical *Carpinus caroliniana*, as recently pointed out by Fernald, is southeastern, and all our Michigan material should be referred to the northern variety.

BOEHMERIA CYLINDRICA (L.) Sw. var. DRUMMONDIANA Wedd. — Infrequent. Wet sandy shore of Cavanaugh Lake, *9090*.

COMMANDRA RICHARDSIANA Fernald. — Common. Open oak woods on Wagner Road, 2¾ miles west of Ann Arbor, *7442*. In the Great Lakes area this plant seems to be best set off from the eastern *C. umbellata* by its corymbose rather than paniculate inflorescence, a character particularly evident in the fruiting stage. *C. umbellata*, according to Fernald, is not known west of the Alleghenies.

POLYGONUM NEGLECTUM Besser. — Common. Gravelly road bordering woods north of Huron River, 1¼ miles east of Ann Arbor, *9099*.

CHENOPODIUM HUMILE Hook. — Waste ground, University of Michigan Botanical Gardens, Ann Arbor, *6858*.

CERASTIUM NUTANS Raf. — Fallow field near the Island, 1 mile northeast of Ann Arbor, *7379;* weed in tall grass, University of Michigan Botanical Gardens, Ann Arbor, *8578*.

DIANTHUS ARMERIA L. — Dry open woods, Pauline Boulevard, Ann Arbor, *9065*.

BUNIAS ORIENTALIS L. — Abundant and well established in low meadow, Nichols Arboretum, Ann Arbor, *7443*. There has been, apparently, only one previous report of the occurrence of this European crucifer in North America: Norman Taylor (*Mem. N. Y. Bot. Gard.*, 5: 349. 1915) reports that it has been collected in the area covered by his *Flora of the Vicinity of New York*, but gives no definite locality for it.

CORONILLA VARIA L. — Grassy field, Packard Road, south of Ann Arbor, *8333*.

TRIFOLIUM ARVENSE L. — Sandy field north of Mill Lake, Section 4, Sylvan Township, *9346*.

Polygala Pretzii Pennell. — Edge of woods on dry slope, Speechley's Woods, $2\frac{3}{4}$ miles east of Ann Arbor, *9206;* open oak slope on Huron River Drive, $3\frac{1}{4}$ miles east of Ann Arbor, *9236.*

Euphorbia Rafinesquii Greene. — Gravelly roadside, $2\frac{1}{4}$ miles east of Ann Arbor, *9116.*

Sida spinosa L. — Weed at the University of Michigan Botanical Gardens, Ann Arbor, *8517.*

Hypericum virginicum L. var. Fraseri (Spach) Fernald. — Wet sandy shore of Crooked Lake, $4\frac{3}{4}$ miles west of Chelsea, *9343.*

Ludwigia palustris (L.) Ell. var. americana (DC.) Fernald & Griscom. — Common. Marshy depression in field on Huron River Drive, $3\frac{1}{2}$ miles east of Ann Arbor, *9237.*

Ludwigia polycarpa Short & Peter. — Swampy roadside ditch, Third Sister Lake, 3 miles west of Ann Arbor, *8357.*

Oeothera rhombipetala Nutt. — Sandy hill east of Sugar Loaf Lake, Section 32, Lyndon Township, *9140.*

Cornus obliqua Raf. — Frequent. Bank of Huron River, Dexter Park, $1\frac{1}{4}$ miles east of Dexter, *9184.*

Chimaphila umbellata (L.) Nutt. var. cisatlantica Blake. — Wooded ravine on Waterloo Road, Section 34, Lyndon Township, *9327.* Typical *C. umbellata* is European, and all southern Michigan material is doubtless var. *cisatlantica.*

Glecoma hederacea L. var. parviflora (Benth.) House. — Low meadow, Cedar Bend, 1 mile northeast of Ann Arbor, *8554.*

Hedeoma hispida Pursh. — Sandy plain, Section 31, Lyndon Township, $6\frac{3}{4}$ miles northwest of Chelsea, *9088½.*

Lycopus americanus Muhl. var. Longii Benner. — Sandy shore of Third Sister Lake, 3 miles west of Ann Arbor, *8377.*

Monarda punctata L. — Sandy plain, Section 31, Lyndon Township, $6\frac{3}{4}$ miles northwest of Chelsea, *9094.*

Teucrium canadense L. var. virginicum (L.) Eaton. — Swale in woods on north bank of Huron River, $1\frac{1}{4}$ miles east of Ann Arbor, *9103.*

Physalis ambigua (Gray) Rydb. — Open woods on steep terrace of Huron River, Cedar Bend, 1 mile northeast of Ann Arbor, *9069.*

Physalis subglabrata Mack. & Bush. — Common. Grassy open slope, near Speechley's Woods, $2\frac{3}{4}$ miles east of Ann Arbor, *9211;* grassy clearing bordering Huron River, $\frac{3}{4}$ mile northeast of Ann Arbor, *9215.*

CHELONE GLABRA L. var. LINIFOLIA Coleman. — Border of pond in low woods, Section 32, Northfield Township, 5¼ miles north of Ann Arbor, *9268*.

MIMULUS RINGENS L. f. PECKII House. — Open sandy shore of Third Sister Lake, 3 miles west of Ann Arbor, *8368*.

UTRICULARIA GIBBA L. — Marly shore of Cassidy Lake, 3¾ miles northwest of Chelsea, *9293*.

GALIUM BOREALE L. var. HYSSOPIFOLIUM (Hoffm.) DC. — Marshy bank of Huron River near Wagner Road, 3¼ miles northwest of Ann Arbor, *9127*.

ANTENNARIA FALLAX Greene var. CALOPHYLLA (Greene) Fernald. — Wooded slope, Section 12, Sharon Township, 6¼ miles south of Chelsea, *8595*.

ANTENNARIA NEODIOICA Greene. — Frequent. Grassy hill east of Hog Back Road, Section 36, Ann Arbor Township, 4 miles southeast of Ann Arbor, *7381*.

ANTENNARIA NEODIOICA Greene var. ATTENUATA Fernald. — Frequent. Grassy hill east of Hog Back Road, Section 36, Ann Arbor Township, 4 miles southeast of Ann Arbor, *7385;* dry open oak woods on Milford Road, Section 36, Northfield Township, 3¼ miles northwest of Dixboro, *7395*.

ANTENNARIA NEODIOICA Greene var. GRANDIS Fernald. — Open oak grove, Cady's Corner, Section 22, Pittsfield Township, 5 miles southwest of Ypsilanti, *8542*.

ANTENNARIA PARLINII Fernald var. ARNOGLOSSA (Greene) Fernald. — Grassy hill east of Hog Back Road, Section 36, Ann Arbor Township, 4 miles southeast of Ann Arbor, *8581*.

ANTENNARIA PETALOIDEA Fernald. — Grassy hill east of Hog Back Road, Section 36, Ann Arbor Township, 4 miles southeast of Ann Arbor, *7386*.

ASTER INTERIOR Wiegand. — Sandy field bordering marsh, Section 31, Dexter Township, 2¼ miles northeast of Chelsea, *9251*.

ASTER LATERIFLORUS (L.) Britton var. PENDULUS (Ait.) Burgess. — Dry open wooded terrace of Huron River, Cedar Bend, 1 mile northeast of Ann Arbor, *9287*.

ASTER VIMINEUS Lam. — Sandy field bordering marsh, Section 31, Dexter Township, 2¼ miles northeast of Chelsea, *9252*.

BIDENS DISCOIDEA (T. & G.) Britton. — Swamp east of Half Moon Lake, Section 6, Dexter Township, *9148½*.

HELIOPSIS SCABRA Dunal. — Border of marsh near Huron River, 1⅓ miles north of Ann Arbor, *8382*.

MATRICARIA CHAMOMILLA L. — Abundant on waste ground, University of Michigan Botanical Gardens, Ann Arbor, *7447*.

PRENANTHES ALTISSIMA L. — Frequent. Oak–maple woods, Section 16, Pittsfield Township, 4½ miles southeast of Ann Arbor, *8397*.

RUDBECKIA TRILOBA L. — Ravine, Nichols Arboretum, Ann Arbor, *9220*.

UNIVERSITY OF MICHIGAN

NOTES ON NEW OR UNUSUAL DISCOMYCETES *

BESSIE B. KANOUSE

IN THIS paper fourteen discomycetes are reported, five of which are new records for the state. Of these, two were collected in Oakland Co., Michigan, by Dr. A. H. Smith on a survey sponsored by the Cranbrook Institute of Science. The collections other than those made in Michigan represent particularly interesting species from various places in the United States. Three fungi are described as new, and one new combination is made. The material is deposited in the Herbarium of the University of Michigan.

List of Species

ALEURIA PSEUDOTRECHISPORA (Schröt.) v. Höhn. — On bare soil in overflow region, Psycht River, Wash., Sept. 25, 1935, A. H. Smith, 2671. Seemingly this is a rare species. It was published as *Lachnea pseudotrechispora* by Rehm (4). The spores, however, are decidedly netted. The paraphyses, which are a conspicuous feature of this species, are abruptly swollen at their apices and are densely filled with orange coloring matter. Our collection has been compared with Rehm's Ascomyceten No. 1629, which was also collected on bare soil.

Beloniella marcyensis, sp. nov.[1] — Apothecia erumpent, sessile, 0.5 mm. in diameter, soft-waxy, dark brown at the base, streaked with brown upward, hymenium rosy flesh color, hypothecium parenchymatic; asci cylindrical, 80 100 × 7–8 μ, 8-spored, not bluing with iodine; spores narrowly ellipsoid, 23 25 × 3 -4 μ, tardily many-celled, hyaline; paraphyses filiform, filled with oil drops.

* Papers from the Herbarium of the University of Michigan.

[1] **Beloniella marcyensis,** sp. nov. - Apotheciis erumpentibus, sessilibus, 0.5 mm. latis, cereis, deorsum brunneis, parenchymaticis; ascis cylindraceis, 80-100 × 7-8 μ, octosporis, J–; ascosporis ellipsoideis, 23–25 × 3–4 μ, uniseptatis dein multiseptatis, hyalinis; paraphysibus filiformibus.

On twig on ground, Mt. Marcy, New York, Aug. 17, 1934. Type collected by A. H. Smith, 316.

BULGARIA MEXICANA Ellis and Holw. — On spruce, Crescent City, Calif., Nov. 3, 1937, A. H. Smith, 8383. This collection consists of one fine large apothecium. The description by Holway (3) of material collected in Mexico in 1896 fits our collection perfectly. Apparently this species is seldom found. The deeply wrinkled stipe and the cracked hymenium, which shows the white interior, are significant aspects of the dried specimen.

Calloria oregonensis, sp. nov.[2] — Apothecia sessile, gregarious, 1 mm. in diameter and nearly as high, hypothecium thick, soft, subgelatinous, parenchymatic, disc flat, "Perilla purple" (R.)[3] outside, paler below, hymenium "light Perilla purple" (R.); asci cylindrical, 8-spored, 120–150 × 7–8 μ, tips of the asci strongly blued with iodine; spores ellipsoid, hyaline, 2-celled, constricted near the middle, 10–12 × 5–6 μ; paraphyses numerous, delicately filiform, stiff, abruptly enlarged at the apices, capitate portion reaching a diameter of 4 μ.

On coniferous wood, Lake Tahkenitch, Ore., Nov. 18, 1935. Type collected by A. H. Smith, 3538; also on spruce log, Trinidad, Calif., Nov. 30, 1935, H. S. Parks and A. H. Smith (S. 3776).

Calloria atrosanguinea Rehm, which was collected on a coniferous log in Washington in 1906 by E. T. Harper and S. A. Harper, seems to be a closely related species. The asci in *C. atrosanguinea* are less than half as long, however, and the spore measurements are sufficiently different to warrant considering our collection a distinct species. One common characteristic is the capitate paraphyses.

DISCINELLA LIVIDO-PURPUREA Boud. — On old wood, Mt Marcy, N. Y., Aug. 16, 1934. A. H. Smith, 383. This fungus is beautifully illustrated and described by Boudier (1). Discinella was described as an inoperculate fungus; hence Saccardo's transference of the genus to Humaria cannot be accepted. The species

[2] **Calloria oregonensis,** sp. nov. — Apotheciis sessilibus, aggregatis, 1 mm. latis, prope 1 mm. altis, subgelatinosis, parenchymaticis, patelliformibus, pallide violaceis; ascis cylindraceis, octosporis, 120–150 × 7–8 μ, J+; ascosporis ellipsoideis, hyalinis, uniseptatis, constrictis, 10–12 × 5–6 μ; paraphysibus tenuiter filiformibus, ad apicem inflatis, 4 μ latis.

[3] Ridgway, R., *Color Standards and Color Nomenclature.* 1912.

in this genus seem to be rarely collected, to judge from their infrequent citations in the literature.

Hyalinia breviascus (P. Henn.) Kanouse, comb. nov. — On Alnus, Rock River, Mich., Aug. 28, 1927, C. H. Kauffman; two collections (R. F. Cain, 7323, and J. H. L. Truscott, 7309) sent to the writer from Canada by H. S. Jackson are also of this species. The species is characterized by its very small asci and spores. The noncapitate paraphyses place it in the genus Hyalinia rather than in the genus Orbilia, in which it was put by Henning. The irregularly disposed material at the tips of the paraphyses forms a crust that flattens out in a layer above the asci. This is quite different from the definitely capitate paraphyses in the genus Orbilia.

LACHNEA PULCHERRIMA Gill. - On dung, Crescent City, Wash., Oct. 3, 1935, A. H. Smith, 2848. According to Seaver (6), this species has a limited distribution in the United States.

MELASTIZA CHARTERI (W. G. Smith) Boud. — On sand, Milford, Mich., Aug. 20, 1937, A. H. Smith, 7144; Sept. 21, 1937, A. H. Smith, 7679. This is the first time the species has been reported from Michigan; Seaver (6) reports it as common in New York.

MOLLISIOPSIS SUBCINEREA Rehm. — On aspen stick, Pontiac, Mich., June 17, 1937, A. H. Smith, 6338. This species was described by Rehm from a collection made in New York on *Thalictrum sp.* by Dr. Fairman. Though our specimens were found growing on a different substratum, they agree with the New York collection in essential morphological characters and so are considered to be of this species. The lance-shaped paraphyses are the conspicuous feature of this genus.

NAEVIA PINIPERDA Rehm. — On Larix needles, Rock River, Mich., June 10, 1933, A. H. Smith, 33-356; Deerton, Mich, June 11, 1933, E. B. Mains, 33-181. The apothecia in these collections are slightly smaller than those described for the species, but it is possible that on the Larix needles they do not attain the maximum size. In all other respects they are alike.

NIPTERA TYROLENSIS (Sacc.) Rehm. — On wet wood lying on the ground, Catlin Lake, New York, Aug. 13, 1934, A. H. Smith, 164. The apothecia are characterized by the reddish brown color of the disc, by the dark color on the outside, and by the branched

paraphyses, which form an epithecium. The asci measure 50–70 × 8 10 μ and do not color blue with iodine.

Otidea Smithii, sp. nov.[4] (Pl. I). — Apothecia solitary or caespitose, arising from a large solid footlike base composed of mycelium intermixed with soil, elongated ear-shaped, split to the base on one side, up to 8 cm. in height, outside of the apothecium "Vandyke brown" (R.) drying "Rood's brown" (R.), hymenium "wood brown" (R.), drying "vinaceous-buff" (R.); asci cylindrical, 100–130 × 10 μ, 8-spored, not bluing with iodine; spores hyaline or faintly yellowish, narrowly ellipsoid, 12–14 × 6–7 μ, containing two small oil drops; paraphyses strongly bent and hooked at their apices.

On soil under pine, Crescent City, Calif., Nov. 18, 1937. Type collected by A. H. Smith, 8843. An additional collection was made at Crescent City, Calif., Dec. 3, 1937, by A. H. Smith, 9340.

The dark brown color of the fresh apothecia at once distinguishes this species from species that become brown only on drying or in age. These specimens resemble *Otidea leporina* in general characteristics, and the two species are undoubtedly closely related, but the marked color difference and the somewhat larger stature of *O. Smithii* establish a distinct species.

PEZICULA ATROVIOLACEA Bres. — On decaying stick in a stream, Marquette, Mich., Sept. 1, 1935, E. B. and E. E. Mains. This species is well illustrated by Bresadola (2). The paraphyses are very prominent, owing to the purplish brown coloring matter that they contain as well as to their large size and the length to which they extend beyond the asci.

PHAEOPHACIDIUM ABIETINUM Sacc. — On *Abies grandis*, Bethlehem Mine, Ida., Sept. 2, 1922, L. E. Wehmeyer. Saccardo (5) described this species from material collected at Spokane, Washington, on *Abies grandis*. Apparently the fungus is not found often. The species is well defined by the dark spores, by the branched paraphyses that form a yellowish epithecium, and by the red color of the ascus pore when treated with iodine.

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[4] **Otidea Smithii,** sp. nov. — Apotheciis sparsis vel aggregatis, sessilibus in sclerotiformibus radicibus, auriformibus, 8 cm. altis, extus nigro-brunneis, hymenio avellaneo; ascis cylindraceis, 100–130 × 10 μ, octosporis, J–; ascosporis ellipsoideis, subflavis, 2-guttatis, 12–14 × 6–7 μ; paraphysibus filiformibus, apicibus curvatis.

Otidea Smithii, sp. nov. × 1. Photograph by Helen V. Smith

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ASCORBIC ACID (VITAMIN C) IN FUNGOUS EXTRACTS

RALPH W. LEWIS

THE physiological significance of vitamin C (ascorbic acid) in plants is little known. Its function might be more easily learned by first studying plants that can be readily handled in the laboratory. This paper reports work which may aid in future investigations by giving data about the amounts of vitamin C produced by fungi and by describing some modification of methods involved.

METHODS

Culture methods. — Two sets of cultures were used: potatoes as a solid substrate and Knop's solution as a liquid substrate. The potatoes were cut into cubes about 0.7 cm. square; 60 grams of these cubes was weighed in four 500-ml. flasks, which were sterilized by the Tyndall method and planted with spore or mycelial suspensions. The cultures were *Cephalothecium roseum*, *Aspergillus niger*, and *Poecilomyces sp.* In this set hyphal tip cultures were not employed. All cultures were grown at room temperature for the length of time indicated in the tables (p. 34). For extraction five grams of mycelium and substrate were removed aseptically.

Knop's solution with 5 per cent glucose served as a liquid medium. Seventy-five milliliters of this medium was measured into 300-ml. flasks. The lot was sterilized by the Tyndall method. Planting of these flasks was with spore suspensions of *Cephalothecium roseum*, *Aspergillus niger*, *Citromyces* (*Penicillium*) *ramosus*, and *Aspergillus flavipes*. The cultures had been purified by hyphal tip isolations. The amount of the "seeding" of one species for the several flasks was made the same, but no precaution was taken to have the amounts for the different species equal. For extraction the whole mycelial mat in one flask was used.

Extraction. — The extracting mixture was 16 per cent trichloracetic acid and 4 per cent metaphosphoric acid, mixed in equal proportions. All solutions were made with water redistilled from

pyrex in order to eliminate the copper from the regular distilled water. The mycelium of the fungus was weighed by filtering the liquid cultures through glass wool and acid-washed sand in an ordinary funnel; the difference in weight gave the weight of the mycelium retained in the filter. The sand, the glass wool, and the mycelium were transferred to a mortar and 10 ml. of the acid mixture was added. The whole was ground thoroughly and centrifuged until the solid material was thrown down; then the clear liquid was decanted. The residue was treated with 10 ml. more of acid mixture, ground thoroughly again, centrifuged, and decanted into the first decantation. The total volume of extract was increased to 25 ml. with the acid mixture, and titrated at once. For cultures grown on potato medium a weighed amount of substrate and mycelium was ground. No attempt was made to separate the substrate from the mycelium of the fungus. The extracts from potato cultures were stored in a refrigerator for a few days before titration.

Preparation of indicator. - About 0.06 gram of sodium 2,6-dichlorobenzenoneindophenol was dissolved in 500 ml. of water. Newer batches of indicator (Eastman Kodak Co.) went into solution readily. It was not necessary to grind them, as had been recommended for the less pure preparations.

Standardization of indicator. — About 50 mg. of ascorbic acid was weighed accurately and diluted to 500 ml. with the acid-extracting mixture. One ml. of chloroform was pipetted into a 10-ml. centrifuge tube, and one ml. of ascorbic acid solution was layered over the chloroform. The indicator was then titrated into the ascorbic acid layer from a microburette. Stirring was accomplished by bubbling nitrogen through the top layer. When approximately enough indicator had been added, the glass tube through which the nitrogen flowed was adjusted so as to mix the two layers thoroughly. The process was repeated until enough indicator had been added to enable the chloroform to retain a faint pink color, which showed the end point. Three titrations were run, the first as an estimation; the other two were taken as accurate determinations. With practice only two titrations were necessary to secure an accurate check. The indicator was freshly prepared about every ten days, stored in the refrigerator, and standardized each time before use.

Titration of extracts. — Titration of the extracts was similar to standardization, the extract being substituted for the standard as-

corbic acid solution. When the chloroform did not separate readily from the extract, owing to the presence of colloids, a few turns in the centrifuge caused it to layer quickly. The end point of the standardization was stable for hours, which enabled direct comparison of the titration end points with the standard. Two titrations of each sample were run. If they failed to check (± 0.02 ml. of indicator), a third was run.

Discussion of methods. — The methods are adaptations from various methods described in the literature. The indophenol titration was chosen instead of one of the several other determinations because of its simplicity and accuracy, and because of its acceptance by recognized authorities. The micromethod, as described, is a combination of the methods used by Birch and others (1) and by McHenry and Graham (3). With the use of chloroform an end point is determined by the color of the chloroform layer, and not by the color of the extract. The unreduced dye is soluble in the chloroform, whereas the plant pigments involved are not. Because of the presence of pigments in the extract little value can be expected from the titrations unless chloroform is used to remove the indicator. This method is to be highly recommended.

Small amounts were used because of the speed and the ease with which the smaller equipment was handled. Trichloracetic-metaphosphoric acid mixture was chosen for extraction because of superior results, as shown by Musulin and King (4). Trichloracetic acid disrupts cell structure more rapidly and has a high deproteinizing action. The metaphosphoric acid protects the ascorbic acid from oxidation when minute amounts of copper are present.

RESULTS

Table I gives results concerning fungi grown on sterilized potato substrate. The calculations were based upon the amount in milligrams of ascorbic acid per gram of mycelium-substrate mixture instead of mycelium alone. It was impossible to separate the fungi from the substrate. A check was run on the sterilized potato substrate. Table II shows the amount of ascorbic acid present in both the mycelium and the liquid substrate, together with the weights of the mycelial mats from which the extractions were made. The ascorbic acid was calculated as milligrams per gram of wet mycelium and as milligrams per milliliter of substrate.

TABLE I

Ascorbic Acid in Fungi Grown on Potato Substrate

Milligrams of ascorbic acid per gram of fungus and substrate are tabulated for various ages of the cultures. The amounts listed are from a single culture of each species.

Age of cultures in days	Cultures			
	Potato substrate	Cephalothecium roseum	Aspergillus niger	Poecilomyces sp.
3	.146	.170	.291	. . .
8	.170	.291	.437	.243
13	.146	.437	.388	.340
18	.300	.575	.450	.525
22	.325	.650	.525	.650

TABLE II

Ascorbic Acid in Fungi Grown on Knop's Solution

Milligrams of ascorbic acid per gram of fungus and milligrams of ascorbic acid per milliliter of substrate are given for different ages of the cultures. The total weight of mycelium in grams is listed.

Age of cultures in days	Data recorded	Control	Cultures			
			Cephalothecium roseum	Aspergillus niger	Citromyces (Penicillium) ramosus	Aspergillus flavipes
7	Weight of mycelium....	..	.400	2.500	2.400	3.800
	Ascorbic acid in mycelium	. . .	1.388	.755	.277	.716
	Ascorbic acid in substrate	....	.020	.036	.022	.109
11	Weight of mycelium ...	. . .	1.580	2.380	3.000	3.410
	Ascorbic acid in mycelium	...	.698	.721	.327	.521
	Ascorbic acid in substrate	.015	.027	.037	.025	.032
14	Weight of mycelium.....	....	1.100	1.800	3.500	3.990
	Ascorbic acid in mycelium	....	.993	.838	.267	.325
	Ascorbic acid in substrate	....	.023	.040	.029	.029
17	Weight of mycelium.....	....	1.250	1.120	3.260	4.240
	Ascorbic acid in mycelium	....	.814	1.382	.339	.250
	Ascorbic acid in substrate	.014	.020	.044	.023	.021

DISCUSSION AND CONCLUSION

It has been assumed that all the reducing substance is ascorbic acid. This, admittedly, is somewhat in error. The evidence (5, 6) shows, however, that most of the substances in plants reducing this indicator, with the exception of ascorbic acid, are present in minute amounts. Table I reveals that the sterilized potato substrate itself has a quite high reducing power. An error, then, is introduced into the amount recorded as being produced by the fungus. In Table II the result of titration of the sterilized liquid medium reveals that it has a reducing power equivalent to 0.014 mg. of ascorbic acid per milliliter.

It was observed that some fungi produce relatively large amounts of ascorbic acid when grown upon either a synthetic or a nonsynthetic medium. The amounts vary with the kind and the age of the fungous colony. Most of the ascorbic acid is intracellular; however, there is for each species of fungus a relatively constant amount of ascorbic acid present in the liquid substrate, regardless of the age of the culture. The intracellular ascorbic acid varies with the age of the culture, but from species to species is not constant in its variation.

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PLANTS PROBABLY UTILIZED BY THE OLD EMPIRE MAYA OF PETÉN AND ADJACENT LOWLANDS *

CYRUS LONGWORTH LUNDELL

THE Old Empire Maya undoubtedly were an agricultural people, as are their modern descendants; they depended largely upon the produce of their cornfields (*milpas*), dooryards, orchards, and the native forests to supply their needs for food and other vegetable products.

The region covered by the Old Empire included most of the Yucatan Peninsula and all the land southward through Guatemala into Honduras and westward into Chiapas and Tabasco. This brief report deals mainly with the plants probably important to the Maya who occupied the Department of Petén, Guatemala, and adjacent lowlands.

The Yucatan Peninsula, south to the Sibun River in British Honduras, and central Petén, Guatemala, is a region rather uniform in both physiography and flora. Tertiary and Recent limestones cover the entire area. The elevation does not exceed four hundred meters, and it averages much less. The coastal country, especially the northern plain, is quite low, being only a few meters above sea level in many localities. In Petén and the interior of Campeche the topography is varied by swampy lowlands (*akalches, bajos*) and well-drained uplands. Soils of the uplands are mostly fertile shallow clays.

The climate is warm, for the peninsula lies entirely within the tropics. There are two seasons: the dry, which extends from November through May, and the wet, which lasts from June to October. March and April are the driest months; June, September, and October have the highest precipitation. Rainfall varies considerably, increasing from north to south. The northwestern tip of Yucatan has a precipitation ranging from only 500 to 850 mm.,

* Papers from the Herbarium of the University of Michigan.

whereas that of the area south to the Sibun River of British Honduras and to central Petén ranges from 850 to 1800 mm. No part of Petén has an average rainfall of less than 1500 mm.

At the base of the Yucatan Peninsula the rainfall, which exceeds 4000 mm. at Punta Gorda, is considerably higher, the topography more varied, and the geological formations older, factors which profoundly affect the vegetation. In southern British Honduras, southern Petén, and parts of eastern Guatemala and Honduras true rain forest exists in which there are many species not encountered in the low xerophytic thickets, dry forest, pine lands, and quasi rain forest to the north.

The plants most important in the economy of the Maya thrive throughout the region. Some species of secondary importance are limited, however, to certain localities, and their availability largely determines the degree of utilization.

In this preliminary attempt to determine which plants were probably utilized by the ancient Maya several lines of investigation have been followed. In surveying the forest covering the Maya ruins in Petén, southern Campeche, and northern British Honduras trees have been found which appear to be relics from former cultivation. Among these are *Achras Zapota* L. (*ya, zapote*), *Brosimum Alicastrum* Swartz (*ox, ramón*), *Talisia olivaeformis* (HBK.) Radlk. (*uayum, guayo*), *Diospyros Ebenaster* Retz (*tauch ya, zapote negro*), *Calocarpum mammosum* (L.) Pierre (*haas, mamey*), *Pseudolmedia spuria* (Swartz) Griseb. (*manax*), and *Persea americana* Mill. (*on, aguacate*). *Achras Zapota* is one of the dominant trees in the greater part of the older upland forest of the Yucatan Peninsula, and its prominence may be due to an advantage accruing to it by former cultivation or protection (2). The *ox* or *ramón* forms veritable groves (*ramonales*) on the old ruins, and the other species, notably the *guayo*, *mamey*, and *aguacate*, are largely restricted to those areas.

The presence of certain trees of economic importance on the ruins could scarcely be accounted for by edaphic factors, for the limy soils covering the ruins probably do not differ appreciably from those of the surrounding country. May we not assume that their presence indicates that the species were planted or given special protection by the Maya and were of some importance in their economy?

The assumption is given more credence when Maya villages of today are surveyed. The same species which in a naturalized state

are restricted to sites of ruins, or which are abundant on the sites of ruins, are among the species commonly planted by the modern Maya. Even a casual observer notes the presence in villages of the *sapodilla*, *mamey*, *ramón*, and *aguacate*. It is true that the *ramón* is planted mainly because of its leaves and twigs, which are cut for fodder, but the same tree is also the source of a nutritious starchy seed which is still eaten boiled or after having been ground into flour and made into bread.

Concerning the great number of plants for which we have no direct evidence, but which undoubtedly played a rôle in the economy of the Old Empire Maya, we must look to contemporary usages for information. It is safe to assume that many practices of the modern Maya are survivals from the past, especially those that utilize native resources. In the following lists I indicate present usage and also point out something of what is known about preconquest practices. Only those species are included which were in the area in pre-Columbian times.

For convenience the plants are divided into the following classes and subclasses.

HUMAN FOODS
- Cereals and vegetables
- Cultivated and semicultivated fruits
- Wild fruits
- Beverage plants
- Plants used for seasoning and flavoring

TIMBER TREES AND OTHER PLANTS USED IN CONSTRUCTION
- Timbers
- Plants with stems or strips of bark suitable for cordage
- Thatching materials

MATERIALS FOR DUGOUTS
FIBER PLANTS
DYE PLANTS
DECORATIONS
SHADE TREES AND ORNAMENTALS
MISCELLANEOUS USEFUL PLANTS

For other reports covering useful plants of the Maya area see Popenoe (5), Thompson (10), Standley (8), Roys (7), Harper (1), and Lundell (2, 3, 4). What is known of the medicinal plants is recorded by Standley and Roys, and no further elaboration on that aspect of the subject seems justified until detailed field investigations have been completed. All the data included here are from accredited sources and the field work of the author.

HUMAN FOODS

Cereals and Vegetables

Zea Mays L. Ixim, maíz, maize

Beyond a doubt maize was the staple food of the ancient Maya, for it was the foundation of aboriginal American agriculture.

For notes on the vernacular names of maize, its cultivation, preparation for food, etc., see Standley (8, p. 191), Roys (7, p. 249), Redfield and Villa (6), and Lundell (4).

Phaseolus vulgaris L. Buul, frijol, bean

Of the several forms of beans cultivated in the region the black variety is commonest, with the red one ranking second. The bean is next to maize in importance as a staple food, and it probably held a similar position among the ancients. It is planted in *milpas* along with maize; the bean vines grow over the corn plants.

Cucurbita moschata Duch. and *C. pepo* L. Kuum, calabaza, squash, pumpkin

Numerous varieties of squash and pumpkins are grown in *milpas* and dooryards. They are planted the first year, but thereafter seeding takes place naturally from ungathered fruits. Squash and pumpkins rank as two of the important secondary foods. The flowers and small tender fruits are prepared by boiling; the mature fruits are baked, boiled, or made into *dulces* ("sweets"); and the kernels, removed from dried seeds, are eaten roasted or in *dulces*.

Ipomoea Batatas (L.) Lam. Iz, camote, sweet potato

Commonly planted in dooryards and often in plots within the *milpas*. Early explorers in Yucatan found it cultivated by the Maya (10, p. 194).

Lycopersicum esculentum Mill. Pak, tomate, tomato

Cultivated to a considerable extent and occurring wild around villages as an escape. The fruits, mostly small and of poor quality, are eaten raw or cooked with meats.

Manihot esculenta Crantz and *M. dulcis* (Gmel.) Pax. Tsin, yuca, cassava

Both species probably were cultivated in the region prior to the

Spanish conquest. The large starchy tuberous roots are boiled and eaten as a vegetable.

Brosimum Alicastrum Swartz. Ox, ramón, breadnut

The *ramón,* although growing wild in the upland forests, is to be classed as semicultivated also. In every village of the modern Maya in the Yucatan Peninsula it is one of the most conspicuous trees, being planted in dooryards, along fences, and in streets.

I found *ramón* groves (*ramonales*) covering the sites of every Old Empire ruin visited in Petén and Campeche, a fact which strongly indicates that the tree must have been planted by the ancients, even as it is now planted by the modern Maya.

The outer covering of the fruits is sweet and edible; the starchy nutritious seeds are boiled and eaten as a vegetable or dried and ground into flour. Trees bear large quantities of fruits, and it is reasonable to suppose that the ancients gathered them in much the same way as do the Maya at present. If we may judge by the extent and distribution of the *ramón* groves, we may assume that the ancients depended considerably upon this source of food. At present the leaves and small stems of the tree serve for fodder also.

Sechium edule (Jacq.) Swartz. Wiskil, chayote

Commonly planted in dooryards. A slender scandent herbaceous vine which bears fruits whose flavor resembles that of summer squash. The fruits, tender shoots, flowers, and tuberous roots are all edible, being boiled and eaten as a vegetable.

Xanthosoma violaceum Schott. Munul, malanga

Commonly planted today in some localities. The roots, leaves, and young shoots are boiled and served as a vegetable. Thompson states (10, p. 192) that the plant may have been introduced recently.

Jatropha aconitifolia Mill. Chay, chaya

Cultivated in dooryards for its edible leaves, which are boiled and served as a vegetable.

Yucca elephantipes Regel. Tuc, palmera

Planted occasionally in dooryards and along fences. The flowers are cooked and eaten as a vegetable or mixed with meats.

Pachyrhizus erosus (L.) Urban. Chicam, jícama

Planted for its turnip-like roots, which are eaten raw. The vine also grows wild in the region.

Orbignya Cohune (Mart.) Dahlgren. Tutz, corozo, cohune

One of the commonest palms of southeastern Campeche, British Honduras, Petén, and eastern Guatemala. The tender buds are boiled, having a strong flavor suggestive of cabbage. Oil from the seeds is used for cooking and also burned in lamps.

Other plants in the region having edible inflorescences, leaves, or fruits are *Chamaedorea spp.* (*xiat, chiat*), *Crotalaria maypurensis* HBK., *Ceiba aesculifolia* (HBK.) Britt. & Baker (*piim, pochote*), *Parmentiera edulis* DC. (*cat*), and *Physalis pubescens* L. (*paknul, tomatillo*).

Cultivated and Semicultivated Fruits

Calocarpum mammosum (L.) Pierre. Haas, mamey, mamey apple

One of the important semicultivated fruit trees indigenous to the general region. Its large sweet red-meated fruits are much esteemed. Trees have been discovered on the sites of Maya ruins, which is a strong indication that the species was planted by the ancients. Early explorers found the *mamey* cultivated around Chetumal Bay on the east coast of the peninsula. It is reported as growing wild in the wet forest of southern Petén, but it has not been found in the forests of northern Petén, northern British Honduras, or Campeche except on the sites of ruins.

Persea americana Mill. On, aguacate, avocado

Commonly planted by the modern Maya. The avocado doubtless played an important part in the life of the ancient Maya. It has been found growing wild in forests covering the sites of ruins in northern British Honduras, but not in forests elsewhere in the peninsula.

Another species with edible fruit, *Persea Schiedeana* Nees, is reported to occur wild in southern British Honduras.

Achras Zapota L. Ya, zapote, chico zapote, níspero, sapodilla, naseberry

The most valuable tree and one of the commonest in the advanced forest covering the uplands of the Yucatan Peninsula. Its abundance

may be due to protection afforded it by the ancient Maya, or the species may even have been planted (2). The *sapodilla* was, beyond a doubt, one of the important trees in the economy of the Old Empire Maya as a source of gum, fruit, and timber. Its wood was used extensively for lintels and other beams. At the present time the tree is commonly planted for fruit and shade. The fruit, highly esteemed in the tropics and elsewhere, has a sweet, delicious brownish flesh. Fruits were ranked next to honey as the source of sweets by the preconquest Maya, and such sweet fruits as the *sapodilla* were probably highly prized. The gum from the tree (chicle of commerce) was chewed to quench thirst.

Carica Papaya L. Put, papayo

Although found growing wild on ruins in open places and in fields, the *papayo* with edible fruits is primarily a cultivated plant of dooryards. The fruit is much esteemed now, and it must have been known to the ancient Maya. Meat wrapped in *papayo* leaves becomes tender.

Annona reticulata L. Oop, anona, custard apple

Of the annonas this species is commonest in cultivation in the Yucatan Peninsula. Its soft custard-like fruits are much eaten by the natives. *Anona* trees, apparently relics from cultivation, grow on old ruins, and other trees with inferior fruits are found in the *sapodilla* forest.

Annona cherimola Mill. Pox, cherimoya

Planted by the modern Maya, but not known to be naturalized or wild in the peninsula. The fruits are esteemed locally.

Four other species, *Annona diversifolia* Safford (*anona blanca*), *A. purpurea* Moc. & Sessé (*polbox, chacoop, anona morado*), *A. muricata* L. (*takob, guanabana, soursop*), and *A. squamosa* L. (*tsalmuy, saramuya*), are planted for their edible fruits.

Talisia olivaeformis (HBK.) Radlk. Kenep, uayum, guayo

Planted in villages for both fruit and shade. Large trees, apparently relics from cultivation, have been found growing on the sites of ruins in Petén. The fruits, seldom more than 2.5 cm. in diameter, have a soft flesh of excellent quality. They are much

esteemed by the Maya, and justly so. The better varieties are worthy of more widespread cultivation.

Spondias purpurea L. Abil, jobo, ciruela, Spanish plum

Planted in and around villages for its red or purple plumlike fruits. The better varieties, which ripen from March to May in the Yucatan Peninsula, are very good.

Anacardium occidentale L. Marañón, cashew

Planted in villages, and trees, apparently wild, grow in the pine ridges of British Honduras. The pulpy receptacles and the roasted seed are both eaten. An agreeable fermented beverage is sometimes made from the fruits.

Chrysophyllum Cainito L. Caimito, star apple

Commonly planted for its sweet sticky fruits, which are eaten raw. Although the species does not appear to be native to the Yucatan Peninsula, and has not been found on the sites of ruins, it probably was known to the preconquest Maya.

Psidium Guajava L. Pichi, guayabo, guava

Cultivated widely through the American tropics. Because it becomes naturalized so easily, the native habitat of the species has not been determined. It doubtless was present in the Yucatan Peninsula in preconquest times. The fruits are much eaten either raw or prepared as *dulces*.

Several other species of *Psidium* with edible fruits are indigenous to the region (9, p. 285).

Diospyros Ebenaster Retz. Tauch ya, zapote negro

Planted sparingly for its fruits. Trees of the species, apparently relics from cultivation, have been discovered growing on ruins in northern British Honduras.

Cordia dodecandra DC. Kopte, siricote

An indigenous tree planted in villages for shade and fruit. The fruits are eaten raw or made into *dulces*.

Pseudolmedia spuria (Swartz) Griseb. Manax, cherry

Frequent on the sites of abandoned ruins and occasional elsewhere in the upland forest. Thompson reports (10, p. 188) that it is

cultivated to a certain extent. The small cherry-like fruits are excellent.

Another closely related species, *Pseudolmedia oxyphyllaria* Donn. Smith, which has similar fruits, occurs in the region.

Among the trees sparingly planted for their fruits are *Lucuma hypoglauca* Standl. (*mamey de Santo Domingo*), *Mammea americana* L. (*chacalhaas, mamey*), *Couepia dodecandra* (DC.) Hemsl. (*uspip, zuspi*), and *Inga Paterno* Harms (*paterna*). None of these has been encountered growing wild in the Yucatan Peninsula.

Bromelia Karatas L. Cham, piñuela

Planted occasionally, and common in a wild state in certain localities. Although very acid, the small fruits have an excellent flavor and are much sought after by the natives.

Ananas comosus (L.) Merrill, the pineapple, may not have been known to the Maya before the Spanish conquest; there is no Maya name recorded for the fruit. The species is grown today throughout the region.

Wild Fruits

The wild edible fruits are numerous. The important ones and some of the less valuable ones are listed here. Doubtless all were known to the Old Empire Maya and utilized to a certain extent.

Byrsonima crassifolia (L.) HBK. Chi, nanze

Common in the savannas of Petén and on the pine ridges of British Honduras. The yellow fruits are gathered in large quantities.

Acrocomia mexicana Karw. Tuk, cocoyol, supa, Mexican wine palm

A very common palm, especially in savannas and inland pine areas. The flesh of the fruit is edible.

Conostegia xalapensis (Bonpl.) Don. Pasita

Common in savanna areas in Petén. The small dark purple fruits are gathered wherever the species grows.

Lucuma campechiana HBK. Kaniztc, mamey ciruela

Common in the *sapodilla* forest. The fruits are yellow, 3 cm. in diameter or smaller, with yellow flesh resembling meat of the *mamey*

(*Calocarpum mammosum* (L.) Pierre), but flavorless. The fruits are borne in great abundance. When there were food shortages such fruits may have been eaten extensively.

The following species of less importance have fruits with edible pulp:

Hirtella americana L. Aceituna peluda
Hirtella racemosa Lam. Aceituna colorado
Licania platypus (Hemsl.) Fritsch. Sunzapote
Muntingia Calabura L. Capulín
Simaruba glauca DC. Pasak
Hymenaea Courbaril L. Pakay, guapinol
Ficus lapathifolia (Liebm.) Miq. Copo, higo
Ficus cotinifolia HBK. Copo, higo
Coccoloba Lundellii Standl. Uva
Coccoloba Uvifera (L.) Jacq. Uva
Rheedia edulis (Seem.) Triana & Planch. Palo bayo
Sideroxylon Gaumeri Pittier. Subul, caracolillo
Byrsonima bucidaefolia Standl. Craboo
Malpighia glabra L. Chi
Malpighia punicifólia L. Tocob
Lantana Camara L. Petekin
Cordia Sebestena L. Zackopte
Inga edulis Mart. Bitze
Ximenia americana L. Saaxnic
Dialium guianense (Aubl.) Steud. Uapake
Ardisia spp.
Chrysobalanus Icaco L. Icaco, coco-plum
Vitis tiliaefolia Humb. & Bonpl. Uva
Passiflora spp.
Cereus spp.

The seeds or kernels of the following species are edible, but are not now gathered to any extent:

Orbignya Cohune (Mart.) Dahlgren. Tutz, corozo, cohune
Scheelea Lundellii Bartlett. Kantutz, corozo
Bactris spp. Jauacte
Pachira aquatica Aubl. Zapotebobo

Beverage Plants

Theobroma Cacao L. Kuku, cacao

Planted in dooryards today; apparently not wild in the Yucatan Peninsula.

Cacao has played an important part in the life of the Maya. The dried and roasted beans are prepared in several ways as a beverage. Until recent times the beans were important as currency. The patron

deity of Maya merchants was the spirit of cacao, Ekchuak (10, p. 185).

Seeds of another species, *Theobroma bicolor* Humb. & Bonpl. (*pataxte*), although reputed to be inferior, probably were also utilized in making beverages.

Lonchocarpus longistylus Pittier. Balche

Concerning the tree Standley says (8, p. 297): "This is one of the most important and interesting trees of the peninsula. By the ancient Mayas the bark was soaked in water with honey and fermented to produce an intoxicating drink called '*balche*'. With this the Mayas were accustomed to intoxicate themselves at religious and other celebrations, and it was also one of the offerings made to the gods. The beverage is still made and used, but syrup is usually employed in place of honey."

Bark of other trees is substituted when this species is not available.

Posole, a mixture of ground maize and water, is a nutritious drink which plays an important rôle in Maya life. At the present time coffee-like drinks are made from the seeds of *Cassia occidentalis* L. (*frijolillo*) and the stems of *Combretum farinosum* HBK. Sap from the *cocoyol* palm, *Acrocomia mexicana* Karw., is fermented to make a wine esteemed locally. *Couma guatemalensis* Standl. (*palo de vaca*), a tree of eastern Guatemala, yields a sweet palatable latex similar to milk; it may have been utilized by the earlier inhabitants of the region.

Plants Used for Seasoning and Flavoring

Capsicum annuum L., *C. frutescens* L., and *C. baccatum* L. Ik, Chile pepper

Peppers are a very important item in the Maya diet; hence they are widely cultivated. For preservation the Maya usually tie the fruits together and dry them.

Vanilla fragrans (Salisb.) Ames. Zizbic, vainilla, vanilla

Indigenous to the upland forests of the region. Cacao drinks are flavored with the pods.

Cymbopetalum penduliflorum (Dunal) Baill.

The tree was well known to the Aztecs, who used the dried petals for flavoring beverages. It is probable that the Maya also were

acquainted with the plant, for the species is indigenous to the general region.

Piper auritum HBK. Maculan

Various dishes are seasoned with the leaves of this common weedy shrub.

Pimenta officinalis Lindl. Pimienta, allspice

Indigenous to the forests of the Yucatan Peninsula. The dried green fruits, the allspice of commerce, is sometimes used for seasoning.

Other plants in the region serve as seasoning and flavoring, but little about them has been recorded.

TIMBER TREES AND OTHER PLANTS USED IN CONSTRUCTION

Most modern Maya houses and other structures are of the thatch-and-pole type described and illustrated by Redfield and Villa (6, p. 33).[1] In construction the Maya utilize certain well-known species of plants for timber, cordage, and thatching materials. Availability, however, largely determines the degree of utilization. The following preliminary list includes some of the plants widely used in construction.

Timbers

Achras Zapota L. Ya, zapote, chico zapote, sapodilla

The hard, durable *sapodilla* wood was well known to the Old Empire Maya, and today the timber is still preferred for posts and beams.

Cedrela mexicana M. Roem. Kuche, cedro, Spanish cedar

The wood is soft, easily worked, and resistant to decay and insects. It serves for window and door frames, windows and doors, furniture, canoes, etc. Doubtless it was utilized by the ancient Maya.

Among the other trees which serve for posts and beams in construction the following are important:

Pimenta officinalis Lindl. Pimiento, allspice
Pithecolobium spp. Yaxek, chimay, tsuiche

[1] Masonry houses are common in the more densely populated areas of northern Yucatan, but the thatch-and-pole types predominate elsewhere in the peninsula.

Vitex Gaumeri Greenm. Yaaxnic
Swietenia macrophylla King. Chacalte, caoba
Piscidia piscipula (L.) Sarg. Habin
Acrodiclidium campechianum (Standl.) Lundell. Ektit, dzol
Apoplanesia paniculata Presl. Chulul
Bucida Buceras L. Pucte
Erythroxylon spp.
Drypetes Brownii Standl. Bullhoof
Dialium guianense (Aubl.) Steud. Uapake, chate
Calocarpum mammosum (L.) Pierre. Mamey
Lucuma spp. Kanizte, zapotillo
Sideroxylon spp Pacece, ciruelillo cimarron, silion
Ocotea Lundellii Standl. Yaaxhochoc, laurel
Nectandra spp. Sakalante, zunonte, laurel
Calophyllum brasiliense Camb. var. *Rekoi* Standl. Santa María
Dalbergia Stevensonii Standl Rosewood
Metopium Brownei (Jacq.) Urban. Chechem negra
Aspidosperma spp. Milady, milady colorado
Sabal spp. Botán

The straight stems of *Xylopia frutescens* Aubl. (*sastante*, pole wood), *Trema floridana* Britton (*capulín cimarron*), and other common species serve for wall uprights and smaller poles used in roof construction. In parts of British Honduras where they are available stems of the palmetto, *Acoelorraphe Wrightii* (Griseb.) Wendl., are given preference as wall poles.

Plants with Stems or Strips of Bark Suitable for Cordage

In the construction of their houses and other buildings the Maya do not use nails or pegs, but tie the parts together with strong vines or strips of bark.

The following vines, mainly species of Sapindaceae, Bignoniaceae, and Malpighiaceae, have tough stems suitable for cordage.

Serjania atrolineata Sauv. & Wright. Ixlotoak, buiche
Serjania mexicana (L.) Willd. Chacak, bolomyok
Paullinia fuscescens HBK. Kexak
Cissus sicyoides L.
Cydista spp.
Adenocalymna spp.
Arrabidaea floribunda (HBK.) Loes. Zacak
Hiraea obovata HBK. Utop-chocak
Tetrapteris Schiedeana Schlecht. & Cham. Bejuco treach
Dichapetalum Donnell-Smithii Engler

Strips of strong pliable bark that serve as cordage are obtained from the five species listed below, the first of which is probably most important:

Dalbergia glabra (Mill.) Standl. Kibix, muc
Trema micrantha (L.) Blume
Hampea trilobata Standl. Moho, toob-hoob
Belotia Campbellii Sprague & Riley. Moho, holol
Cochlospermum vitifolium (Willd.) Spreng. Cho, pochote, chum

Thatching Materials

Sabal mayarum Bartlett. Botán, huano

The leaves are much used for thatching. When *milpa* clearings are made the Maya spare the thatch palms, probably a survival of an earlier practice.

Orbignya Cohune (Mart.) Dahlgren. Tutz, corozo, cohune

In the areas of higher rainfall, where the *corozo* grows, its huge pinnate leaves are esteemed almost as much as those of the *botán* palms for thatching material. In addition, the leaves serve for walling up sides of houses, granaries, etc.

Scheelea Lundellii Bartlett. Kantutz, corozo

The large pinnate leaves are cut for the same purposes as those of *Orbignya Cohune* (Mart.) Dahlgren.

In the absence of these palms the leaves of other species may be substituted.

Imperata contracta (HBK.) Hitchc. Ac

A coarse perennial grass growing in savannas. In ancient times it was gathered to roof houses and make granaries (7, p. 213). Natives now cut it for thatching and stuffing packsaddles.

MATERIALS FOR DUGOUTS

The Maya hew dugouts from the trunks of the following trees:

Cedrela mexicana M. Roem. Kuche, cedro, Spanish cedar
Ceiba pentandra (L.) Gaertn. Yaxche, ceiba
Enterolobium cyclocarpum (Jacq.) Griseb. Pich, guanacaste, tubroos
Swietenia macrophylla King. Chacalte, caoba
Calophyllum brasiliense Camb. var. *Rekoi* Standl. Santa María
Vochysia hondurensis Sprague. Sayuk, palo bayo

Poles cut from the straight stems of *Xylopia frutescens* Aubl. (*sastante*) are used for poling boats in both inland and coastal waters. Paddles are made from the soft wood of the Spanish cedar, *Cedrela*

mexicana M. Roem. Resin for caulking is obtained from the trunk of *Symphonia globulifera* L. f.

FIBER PLANTS

Gossypium spp. Tsiin, taman, algodón, cotton

Grown on a considerable scale by the preconquest Maya, for cotton cloth was their principal textile; it furnished the material for most of their clothing. The Maya are reputed to have been excellent weavers.

Very little cotton is planted now because imported fabrics have displaced the native industry. Some of the older Maya have a few plants in dooryards, but the cotton is employed solely for candle-wicks and mending. The death of the industry in the peninsula appears to have been quite recent, for the writer obtained in Chan Laguna, Campeche, and San Andrés, Petén, cloth which had been woven within the past four decades. A few spindles and looms are still kept as souvenirs by the older Maya.

Agave sisalana Perrine and *A. fourcroydes* Lem. Ki, henequén

Both were probably cultivated by the Maya prior to the conquest. The long *sisal* fiber obtained from the leaves, exported today from Yucatan in large quantities for the manufacture of binder twine, is used locally for making hammocks, nets, bags, ropes, cord, and other things.

Desmoncus spp. Bayal

The spiny clambering *bayal* palms are important as the source of the material used extensively in basketmaking. The stems are cut into long narrow strips, which are strong, durable, and sufficiently flexible to permit the weaving of any type of basket.

Sabal mexicana Mart. Bonxaan, huano de sombrero

The young leaves are utilized for making hats and mats. The palm, planted widely in Maya villages, has not been found growing wild in the Yucatan Peninsula.

Typha angustifolia L. Puh, cattail

Mats are sometimes woven from cattail leaves.

Among other plants with strong fibers of lesser economic importance in the leaves, stems, or bark the following are worthy of mention:

Aechmea magdalenae André. Cham, piñuela
Sida acuta Burm. Chichibe
Abutilon lignosum (Cav.) Don. Zacxiu, yaxholche
Muntingia Calabura L. Capulín
Heliocarpus spp.
Hibiscus tiliaceus L. Xholol
Guazuma ulmifolia Lam. Pixoy
Belotia Campbellii Sprague. Moho

Natives gather the short cottony fiber attached to the seeds of *Ceiba aesculifolia* (HBK.) Britt. & Baker (*kinin, piim, tinanche*), *Ceiba pentandra* (L.) Gaertn. (*yaxche, ceiba*), and species of *Ochroma* (*polak, balsa*) for stuffing pillows and mattresses. The fluff from the fruiting spikes of *Typha angustifolia* L. (*cattail*) and the soft fiber on the trunks of *Thrinax* (*chit*) serve the same purpose.

DYE PLANTS

Because of the universal use of aniline dyes at present, natives know little about indigenous plants from which preconquest Maya may have obtained their dyes. Probably all the species listed here were important sources.

Bixa Orellana L. Kuxub, achiote, arnatto

Planted in and around villages for its fruits, which yield an orange-red dye. The ancient Maya undoubtedly utilized vegetable dyes not only in coloring foods and dyeing, but also in painting and decorating, and it is probable that this tree was one of the important sources of red dye.

Haematoxylum campechianum L. Ek, palo de tinta, logwood

Common in the swamps of the Yucatan Peninsula. The heartwood, the logwood of commerce, which yields haematoxylin dye, was formerly exported in vast quantities.

Chlorophora tinctoria (L.) Gaud. Mora

Planted around villages and naturalized. The tree furnishes the fustic wood of commerce, from which yellow, brown, and green dyes are obtained.

The six plants listed below also yield dyes:

Sickingia salvadorensis (Standl.) Standl. Chacahuante, chactemuch, palo colorado
Jacobinia spicigera (Schlecht.) L. H. Bailey. Añil
Indigofera suffruticosa Mill. Choh, añil
Morinda yucatanensis Greenm. Xhoyoc, bejuco piñoncillo
Caesalpinia platyloba Wats. Chacte
Ditaxis tinctoria (Millsp.) Pax & Hoffm. *Tinta roja*

DECORATIONS

Plumeria rubra L. Nicte, flor de Mayo

Commonly planted in dooryards and around churches. In religious celebrations and during other festivals the red, white, and yellow flowers of the *nicte* are strung on cords as decorations.

Jacquinia spp. Chacsik

Necklaces and personal adornments as well as decorations for festal occasions are made by stringing the stiff orange and red corollas. It is probable that the Old Empire Maya decorated temples with the flowers of both the *nicte* and the *chacsik*.

Bombax ellipticum HBK. Chulte, amapola

The large flowers are sometimes cut to decorate houses and churches.

The black seed of *Canna edulis* Ker. (*chankala, platanillo*), the scarlet and black seed of *Abrus precatorius* L. (*xocoak*) and *Rhynchosia pyramidalis* (Lam.) Urban, and the fruits of *Acrocomia mexicana* Karw. (*cocoyol*) are strung as necklaces and bracelets.

SHADE TREES AND ORNAMENTALS

Many of the plants in Maya villages serve several purposes. Such trees as the *sapodilla, caimito, guayo, anona, ramón, mamey, aguacate,* and *siricote* furnish food, yet also comprise the principal shade species. The *siricote* and *flor de Mayo* may also be classed as ornamentals because of their showy flowers. Some of the ornamental herbs and shrubs as well as shade trees find use in local medicine and in Maya rituals.

Of the other trees either planted or spared for shade the following are worthy of mention:

Tabebuia pentaphylla (L.) Hemsl. Maculis, hokab
Guazuma ulmifolia Lam. Pixoy
Bombax spp. Chulte, amapola
Ceiba spp. Kinin, ceiba
Cedrela mexicana M. Roem. Kuche, cedro, Spanish cedar
Cassia grandis L. Bukut, cañafístula
Ficus spp. Copo, higo, chimón

The Ficus species begin as hemiepiphytes, generally along fence rows, and grow into large trees.

For living fence posts the natives plant *Cochlospermum vitifolium* (Willd.) Spreng. (*cho, pochote*), *Spondias Mombin* L. (*jobo*), *Bursera Simaruba* (L.) Sarg. (*chacah*), and *Erythrina rubrinervia* HBK. (*pito*). These also may be considered shade trees.

Conspicuous among the ornamental herbs, shrubs, and trees are the following species, most of which are grown in dooryards:

Bernoullia flammea Oliver. Uacut
Hippeastrum puniceum (Lam.) Urban. Lirio
Zephyranthes spp. Hacinto
Neodonnellia grandiflora (Donn. Smith) Rose
Antigonon leptopus Hook. & Arn. Chaclomacal, San Diego
Gomphrena globosa L. Chacmol, amor seco
Calliandra Deamii (Britt. & Rose) Standl. Tukuy, mota
Euphorbia pulcherrima Willd. Hoja de pascua
Begonia nicaraguensis Standl.
Thevetia peruviana (Pers.) Schum. Acitz
Solanum Seaforthianum Andr. Lágrima de la Virgin
Solanum Wendlandii Hook. f.
Petrea volubilis L. Yochopptzimin, Santa Rita

MISCELLANEOUS USEFUL PLANTS

Crescentia Cujete L. Luch, jícara, calabazo, calabash

Common in savannas and pine lands and planted widely in villages. From the hard shells of its fruits are made cups, bowls, and other utensils.

Lagenaria siceraria (Molina) Standl. Bux, lek

Cultivated in *milpas* and dooryards along with squash and pumpkins. Because of their variable form and greater size its fruits are utilized in making utensils even more than are the fruits of the calabash tree. The *bux* variety, used mainly for water bottles, is constricted in the center, whereas the *lek* is globose and serves as bowls and other food containers. The species is supposedly a native of Africa; hence it may not have been known to preconquest Maya.

Nicotiana Tabacum L. Kutz, tobaco, tobacco

The plant is grown today in dooryards, but its cultivation was probably more extensive in Old Empire times, for its use was widespread among the ancient peoples of tropical America.

Zamia furfuracea L. f. Camotillo

Common in forest through peninsula. The roots are reputed to be used to poison rats and for criminal purposes. When cooked, the roots are edible, for heat destroys the poisonous properties.

Acacia Farnesiana (L.) Willd. Kankilizche

Perfume is obtained from the flowers, and ink from the pods.

Castilla elastica Cerv. Kiikche, ule

Planted in and around villages, and may occur wild in some parts of the Maya area. The tree yields the rubber which was used by the preconquest Maya in making the balls for the game *pelote*. At the present time cloth is waterproofed with the latex.

Protium Copal (Schlecht. & Cham.) Engl. Pom, copal

Cultivated by the ancients, which may account for its widespread distribution through the forests of the Yucatan Peninsula at the present time. The resin, obtained from cuts in the trunk, is used extensively as incense.

Bursera Simaruba (L.) Sarg. Chacah, gumbo-limbo

Resin from the trunk of the *chacah,* one of the commonest forest trees in the Yucatan Peninsula, also serves as incense.

Pinus caribaea Morelet. Huhub, pine

The Maya utilize the pitchy wood for torches.

Arthrostylidium Pittieri Hack. Tzenet, carrizo

Stems of this species and also those of a common riparian bamboo, *Arthrostylidium spinosum* Swallen, are frequently used in making fish spears.

Curatella americana L. Saha, yaha

The rough leaves, which have a surface resembling sandpaper, are employed in smoothing wood and other materials. Leaves of species of Tetracera are similarly used.

Sapindus Saponaria L. Zubul, jaboncillo, soapberry

Pulp of the fruits, rubbed in water, gives a soapy lather, which is substituted for soap.

Quararibea Fieldii Millsp. Maha

Swizzle sticks to froth cacao drinks are made from small branches of the tree.

Stems of species of Paullinia, Serjania, Jacquinia, and Salmea, which contain fish poisons, are macerated and thrown into ponds or quiet streams to stupefy fish so that they may be collected.

At least four trees, *Rhizophora Mangle* L. (*tapche*, *red mangrove*), *Curatella americana* L. (*saha*), *Pithecolobium albicans* (Kunth) Benth. (*chimay*), and *Albizzia Lundellii* Standl., contain tannin in their bark and are utilized for tanning.

The large leaves of species of Calathea and Heliconia are employed in wrapping tortillas and other articles of food.

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STUDIES OF DERMATOPHYTIC FUNGI WITH REFERENCE TO THE SUSCEPTIBILITY OF GUINEA PIGS

ADELIA McCREA

FOR several years the writer has been using guinea pigs in the study of dermatophytic fungi which cause tinea in human beings. This disease has many nicknames, such as "student itch," "golfer's itch," "dhobie itch," "Hong Kong foot," and "athlete's foot." It is very contagious and may readily be picked up, for example, in gymnasia or in public pools. It is not a deadly disease. Many people have tinea for years, regarding it as a rather necessary evil and at one time or another trying as a cure practically everything in the armamentarium. It is probable that the fungi are able to develop lesions only when they enter the tissues through some abrasion of the skin, or in neglected parts of the body, such as the interdigital spaces or the ear.

It may be true that medical mycologists are too conservative in the number of species they are willing to include as parasitic on human skin. Certainly one finds in lesion scrapings many fungi of the common species, e.g., those of Aspergillus, Penicillium, Briarea, and Alternaria. Nevertheless, only the established pathogenic genera — Trichophyton, Epidermophyton, Achorion, and Microsporum — are included in this report, since they are known to be causative organisms in various forms of tinea and in favus. No report on clinical work is given. With one exception, *Microsporum felineum*, all fungi used were isolated from human lesions, but this paper concerns only experimental studies of lesions produced by the fungi on guinea pigs.

The historical background will not be included. The literature is voluminous, and good bibliographies are readily available. Therefore the available space will be used to describe experimental methods, to give the results obtained, and to draw such conclusions as may be evident from them.

METHODS

When suitable methods are followed guinea pigs prove to be quite susceptible to infection by dermatophytic fungi. The percentage of "takes" runs from 70 to 95, depending upon the species of fungi used and varying with the age, but not the sex, of the animals. The dorsum is depilated, and two or four areas are lightly scarified with sterile needles until the plasma oozes to the surface. Into this the inoculum is gently rubbed and allowed to dry before the animal is removed from the board. Infection occurs in five to ten days. Lesions hold a good optimum for another ten days to two weeks, after which, if they are not interfered with, spontaneous recovery usually begins. Thus there is a reasonable period, three to four weeks, during which experimental work may proceed. Throughout the studies here reported the author's previously described method [1] was followed. Each animal in a test was made to serve as his own control by leaving at least one lesion untouched by treatment of any kind.

Fungous extracts of the chosen species were prepared by the usual methods. Cultures were grown to full maturity, and the mats were collected, ground, extracted, and adjusted for nitrogen content. Fungous filtrates were simply the adjusted filtered fluids in and upon which the fungi had grown.

DIAGNOSTIC STUDIES

Diagnostic experiments were made after lesions had reached optimum development. It was found, practically without exception, that these extracts and filtrates were not specific. A greater reaction usually occurred when the extract had been derived from the causative species of the lesions, but good reactions were frequently obtained when an extract of a different species was used. For example, when skin tests were made on the shaved abdomen of a guinea pig exhibiting good dorsal lesions due to *Trichophyton interdigitale* with extracts of (*a*) *T. interdigitale*, (*b*) *Achorion gypseum*, (*c*) *Epidermophyton rubrum*, and (*d*) *Microsporum fulvum*, typical results would show for (*a*), ++++; for (*b*), ++ to +++; for (*c*), + to ++; for (*d*), ++ to +++ (occasionally ++++). Such lack of definite spe-

[1] McCrea, Adelia, "Parasitic Fungi of the Skin," *Journ. Trop. Med. and Hyg.*, 34: 204–206. 1931.

cificity indicates a very limited field for use of fungous extracts and filtrates as diagnostic agents, at least any thus far tested.

THERAPEUTIC STUDIES

So far as curative power may be judged by the effect on guinea pigs, these protein extracts appear of doubtful value. Results obtained were somewhat better than any heretofore reported; nevertheless, the period of optimum infection of these animals is too short to permit accumulation of dependable data by any methods yet developed. Clinical work is the only safe criterion, and reports of various workers disagree so markedly that the treatment of choice remains the old one of keratolyzing and desquamating, followed by healing applications.

IMMUNITY

Much effort has been expended toward developing immunity from fungous infections, similar to the protection from bacteria, but the problem is far from solution. For those unfortunate ones who are not naturally immune, the a priori outlook is not at all promising, for even a severe attack does not confer freedom from subsequent invasions by the same organism. Typical tinea lesions are repeatedly produced by reinfection or by recurrence of the "soil complex" which makes it possible for the dormant fungus to become active again under favorable conditions. This lack of immunizing constituents in the extracts from fungi seems inconsistent for a group so active biologically, but it is established only too well by the unfortunate "repeater" patient, who suffers periodical attacks year after year. In the guinea pig the same area can be infected at least four times by the same culture, even though the skin is allowed to recover fully after each lesion.

DESENSITIZATION

Attempts toward desensitization of susceptible individuals have shown that biological and biochemical methods so far developed are still inadequate. The outstanding work of Sabouraud, Bloch, and Jadassohn in Europe and of Sulzberger, Peck, and others in America clearly indicates possibilities of circumventing the fungi, but it also shows that the need is far from being met. Even when skin tests give positive reactions, as they frequently do, it cannot be said unequivocally that the infection is present *at the time*. The

reaction is often interpretable as a response to former infection. This helps to explain the not uncommon reactions in "normal" individuals who are being used as controls.

When normal animals were given preliminary injections of an extract or a filtrate by gradually increasing dosage over a period of two to four weeks and were then inoculated with the corresponding organism results were invariably disappointing. Instead of protecting them the treatment increased their sensitivity, so that ensuing lesions generally were decidedly more severe than those obtained on normal controls.

IDS

Under the designation "microbids" are included such phenomena as tuberculids, trichophytids, moniliids, and others. These are sterile swellings or eruptions that occur in the skin of infected individuals and clear up without treatment when the infection has been conquered. It may be said that ids do not develop readily in the guinea pig. Not even a tendency to do so has ever appeared during this work. Even when areas not too remote from the active lesions were deliberately injured to invite id formation, none ever were obtained.

DISCUSSION

From the foregoing data it can be seen that the outlook under present methods is not very encouraging. Yet the need of help is fully acknowledged by physicians, both general practitioners and those who have specialized in dermatology. A busy doctor regrets the necessary loss of time while he strives to determine whether he is dealing with a fungous infection or some other skin disease. In the former case, to what genus (a doctor rarely attempts classification of the species) does the fungus belong, and to what treatment may it be expected that response will be favorable? If a diagnostic product could be developed that would serve to distinguish skin disease *due to fungus* from skin disease *due to another cause*, it would be a most welcome advance. If, in addition, it should possess therapeutic properties, its value naturally would be greatly enhanced.

Tinea is both infectious and contagious. Medical interest in the causative organisms is becoming keener because the disorders due to fungi are increasing. The problem needs closer coöperation between mycologists and clinicians, but even a graduate mycologist usually knows little or nothing about these fungi. For this reason every

major university, especially those with medical schools, should have at least one graduate student working on the problem of dermatophytic fungi. The fungi of human pathology are legitimate material for study in botany departments quite as much as those of phytopathology, yet the latter continue to monopolize the attention of practically all our mycologists.

SUMMARY

1. Guinea pigs weighing 200–300 grams are decidedly susceptible to infection by dermatophytic fungi. Though the lesions are subject to spontaneous recovery, the period of optimum infection is sufficiently long for most experimental purposes.

2. Maximum skin reaction is obtained with an extract of the causative fungus of the lesions, but extracts of other species, even of other genera, are capable of producing good reactions which increase the difficulty of diagnosis.

3. Reactions which occur in "normal" individuals are probably in response to a previous infection or to the presence of a dormant organism.

4. Experiments toward desensitization resulted in negative, or reversed, results. Protection was never secured, and frequently the animals showed considerably increased susceptibility to subsequent inoculation.

5. No formation of ids occurred in guinea pigs, nor could such structures be induced to form in these animals under conditions favorable for their appearance.

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NEW SUMATRAN PLANTS. IV

ELMER D. MERRILL

THE purpose of this paper, the fourth in the series, does not differ from that of the preceding ones.[1] There are included undescribed species from Sumatra, together with records of extension of range of species originally described from extra-Sumatran specimens not hitherto reported as occurring on the island. Like the previous papers this one is largely based on material assembled through the efforts of Professor H. H. Bartlett, of the University of Michigan. Specimens of all species considered are deposited in the Herbarium of the University of Michigan; the available duplicates will be distributed by that institution. The actual types of most of the species here described are preserved in the Herbarium of the Arnold Arboretum; a few are in the Britton Herbarium, New York Botanical Garden. In the present paper eighteen species are described as new and about fifty-five previously described are for the first time recorded from Sumatra. Representatives of fourteen genera are added to the Sumatran list: Stenomeris, Phacelophrynium, Stixis, Rhynchosia, Longetia, Pterococcus, Sphaerostylis, Stackhousia, Gardneria, Spigelia, Nosema, Microtoena, Galinsoga, and Blainvillea.

List of Species

DIOSCOREACEAE

STENOMERIS BORNEENSIS Oliv., in Hook., Ic., 24, t. 2328. 1894; Knuth, Pflanzenr., 87 (IV.43) : 344, f. 67 M–R. 1924.

Stenomeris mindanaensis Knuth, *op. cit.*, 346.

SUMATRA, East Coast, Bila, Rantau Parapat, *Rahmat 1737*, March–May, 1932; local name *damar-damar*. Borneo, Mindanao. The genus is new to the records of Sumatra.

[1] Merrill, E. D., "New Sumatran Plants. I," *Pap. Mich. Acad. Sci., Arts, and Letters*, 19 (1933) : 149–204, pls. 16–35. 1934; II, *ibid.*, 20 (1934) : 95–112. 1935; III, *ibid.*, 23 (1937) : 177–202. 1938.

Stenomeris mindanaensis Knuth was described from a specimen I collected in Mindanao and on *Hose 126* from Sarawak, Borneo. On the basis of the material available to me for study (I have not seen Oliver's type) I reduce it to *S. borneensis* Oliv.

MARANTACEAE

PHACELOPHRYNIUM BRACTEOSUM (Warb.) K. Schum., Pflanzenr., 11 (IV.48): 123. 1902; Perk., Frag. Fl. Philip., 71, t. 3, f. A–E. 1904.

Phrynium bracteosum Warb., ex K. Schum., *l.c.*, in syn.

SUMATRA, Tapianoeli, Padang Si Dimpoean, Padang Lawas, Sopsopan, on Aek Si Olip, *Rahmat 5097*, July, 1933; local name *ihit*. Borneo, Philippines. The genus is new to the records of Sumatra.

MORACEAE

FICUS CHARTACEA Wall., List, no. 4580. 1832 (*nomen nudum*); Hook. f., Fl. Brit. Ind., 5: 533. 1888; King, Ann. Bot. Gard. Calcutta, 1: 159, t. 203. 1888; Ridl., Fl. Malay Penin., 3: 350. 1924; Gagnep., in Lecomte, Fl. Gén. Indo-Chine, 5: 789. 1928.

SUMATRA, East Coast, Asahan, near Aek Salabat, northeast of Tomoean Dolok, altitude about 450 m., *Rahmat 9613*, July, 1936; local name *kajoe pornga-pornga batoe*. Burma, Siam, Indo-China, southern China, and the Malay Peninsula.

Artocarpus Griffithii (King) Merrill, comb. nov.

Artocarpus Gomeziana Wall. var. *Griffithii* King, Ann. Bot. Gard. Calcutta, 2: 16, t. 14B. 1889.
Artocarpus Gomeziana sensu Ridl., Fl. Malay Penin., 3: 355. 1924, *non* Wall.

SUMATRA, East Coast, Asahan, near Loemban Ria, *Rahmat 7514*, *8042*, April, 1934; near Aek Moente (Aer Moette), northeast of Tomoean Dolok, *Rahmat 9292*, June–July, 1936; local names *kajoe mobi, kajoe mobi galak*. Also represented by *Krukoff 4372* from Hoeta Padang, Asahan. Malay Peninsula.

Trécul validated *Artocarpus Gomeziana* Wall. in publishing the first description of it in 1847. This description was based wholly on the specimen of *Wallich 4660* in the Delessert Herbarium. In the holotype, with an excellent photograph of which Dr. Hochreutiner

courteously supplied me, the leaves are 19–24 × 13–17 cm. (7–9.5 × 5–7 in.), as indicated by Trécul. For the same species King gave me the measurements as 3.5–7 (rarely 11) × 1.5–4 in.; apparently his description was largely based on the Malay Peninsula form rather than on the Burma one. Ridley states that the leaves are 3–6 × 1.5–3 in., measurements manifestly taken entirely from the Malay Peninsula specimens. He also cites both of King's plates, 14A (*A. Gomeziana* Wall.) and 14B (*A. Gomeziana* Wall. var. *Griffithii* King), as representing his concept of *A. Gomeziana* Wall., and regarding var. *Griffithii* King he states: "The common form [in the Malay Peninsula] is var. *Griffithii* King, with small leaves, but I doubt if this is anything more than a full-grown tree." The Sumatran material clearly represents the same species as the common Malay Peninsula form. *A. pomiformis* Teysm. & Binn., type from Java, represents a distinct species known only from that island It was erroneously reduced to *A. Gomeziana* Wall. by King. In my opinion the form of the Malay Peninsula and Sumatra with smaller and much narrower leaves represents a species distinct from the broad-leaved Burma form, which is typical *A. Gomeziana* Wall.

URTICACEAE

Laportea sumatrana Merrill, sp. nov.

Arbor parva vel frutex, partibus junioribus inflorescentiisque pilos urentes gerentibus, ramis glabris, ramulis ultimis circiter 3 mm. diametro; foliis chartaceis, oblongo-ellipticis, integris vel obscure denticulatis, 15–25 cm. longis, 5.5–9 cm. latis, acuminatis, basi acutis vel rotundato-obtusis, supra glabris vel pilos valde conspersos albidos gerentibus, densissime puncticulatis, subtus praesertim ad costam nervosque pilos conspersos albidos 1–1.5 mm. longos numerosos patulos vix urentes gerentibus, nervis primariis utrinque 12–15, subtus elevatis, perspicuis, fere ad marginem curvato-anastomosantibus; stipulis ovatis, acuminatis, carinatis, hirsutis, circiter 1 cm. longis; petiolo 3–7 cm. longo; paniculis ♀ circiter 15 cm. longis, consperse ciliato-urentibus, ramis primariis paucis, 4–5 cm. longis, bracteis triangulari-ovatis, acuminatis, 1.5 mm. longis, floribus ♀ fasciculatis, flabellatim dispositis, fasciculis circiter 8-floris, sessilibus vel breviter pedunculatis, sepalis 4, subaequalibus, parvis, circiter 0.5 mm. longis, receptaculo circiter 1.5 mm. diametro; stylis circiter

3 mm. longis, puberulis; acheniis ovoideis, glabris, laevibus, compressis, 3 mm. longis.

SUMATRA, East Coast, Asahan, near Loemban Ria, *Rahmat 6925* (type), *7851*, Feb. 6 to April 12, 1934; local names *latong andorasi*, *kajoe latong andorasi*.

This species is characterized by numerous white, weak, slender, spreading, scarcely stinging hairs on the lower surface of the leaves, not only on the midrib and lateral nerves but also on the parenchyma. Perhaps too closely allied to *Laportea stimulans* (Linn. f.) Miq.

PROTEACEAE

Helicia brachyantha Merrill, sp. nov.

Arbor, foliis coriaceis, subtus minute adpresseque cupreo-pubescentibus, margine perspicue dentatis vel dentato-serratis, ramis teretibus, glabris, ramulis ultimis dense adpresse breviter cupreo-pubescentibus; foliis coriaceis, rigidis, oblongis vel anguste oblongo-obovatis vel late oblongo-oblanceolatis, 15–22 cm. longis, 6–8 cm. latis, siccis supra glaberrimis, nitidis, viridibus vel olivaceo-viridibus, junioribus subtus cupreis, vetustioribus pallide brunneis, dense adpresse breviter cupreo-pubescentibus, basi cuneatis, apice acuminatis, margine grosse dentatis vel dentato-serratis, dentibus numerosis, interdum incurvatis, margine prope basim integris; nervis primariis utrinque 9–11, subtus perspicuis, elevatis, arcuato-anastomosantibus; reticulis laxis; petiolo 0.5–2 cm. longo, adpresse cupreo-pubescenti; racemis axillaribus, solitariis vel binis, breviter adpresse cupreo-pubescentibus, multifloris, 5 9 cm. longis; floribus parvis, circiter 6 mm. longis; pedicellis brevibus, 1–1.5 mm. longis, deorsum breviter connatis; perianthii segmentis extus dense breviter adpresse cupreo-pubescentibus, 6 mm. longis; antheris 2 mm. longis; ovario dense adpresse cupreo-ciliato; glandulis hypogynis 4, liberis, glabris, truncatis, anguste oblongis, 1 mm. longis; stylis glabris, 4 mm. longis; fructibus junioribus glabrescentibus.

SUMATRA, East Coast, Asahan, near Loemban Ria, *Rahmat 7543*, *7655* (type), *7694*, *8056*, *7812*, Feb. 5 to April 12, 1934; near Aek Moente, northeast of Tomoean Dolok, *Rahmat 9289*, June, 1936; local names *kajoe sippoer*, *kajoe sippoer gading*, *kajoe sippoer tombak*, *kajoe si hondoeng*, *kajoe si djogor*.

A species characterized by coarsely toothed leaves, which are glabrous and shining above and densely but very shortly appressed cupreous-pubescent beneath, by the indumentum, which is nowhere velvety or tomentose, and by the unusually short flowers.

HELICIA KINGIANA Prain, Kew Bull., 342. 1912; Gamble, Journ. As. Soc. Bengal, 75 (2) : 343. 1914 (Mater. Fl. Malay. Penin., 5 : 343); Ridl., Fl. Malay Penin., 3 : 142. 1924.

SUMATRA, Tapianoeli, Padang Si Dimpoean, Padang Lawas, *Rahmat 4691, 4746, 5092, 5294*, June 22 to Aug. 28, 1933; local names *kajoe si holip, kajoe soelim;* East Coast, Asahan, Loemban Ria, *Rahmat 6445, 6828, 7637*, Feb., 1935; local names *kajoe daroedoeng, kajoe hahondoeng, kajoe si hondoem.* Malay Peninsula.

Helicia oblanceolata Merrill, sp. nov.

Arbor, ramis teretibus, glabris, ramulis ultimis leviter hirsutis, 1-1.5 mm. diametro; foliis siccis utrinque viridibus, glaberrimis, subcoriaceis, integerrimis, oblanceolatis, 8-14 cm. longis, 1.5-3 cm. latis, graciliter acuminatis, basi cuneatis, nervis primariis utrinque circiter 9, gracilibus, arcuato-anastomosantibus; reticulis laxis; petiolo 6-10 mm. longo; racemis numerosis, axillaribus, gracilibus, solitariis vel binis, 7-10 cm. longis, multifloris, consperse subcastaneo-villosis, pedicellis brevissimis; floribus (immaturis) saltem 5 mm. longis, glabris vel alabastris leviter pubescentibus; bracteis lanceolatis, acuminatis, circiter 3 mm. longis, submembranaceis, consperse subcastaneo-villosis.

SUMATRA, East Coast, Tapianoeli, near Loemban Loboe, Toba, kilometer 142, road from Porsea to Parapat, *Rahmat 9798*, July 31, 1936.

A species characterized by unusually small, entire, oblanceolate, slenderly acuminate leaves, which are green or somewhat yellowish green on both surfaces when dry, by small flowers, and by rather conspicuous pubescent bracts. Its alliance seems clearly to be with *Helicia excelsa* Blume.

MENISPERMACEAE

LIMACIA OBLONGA (Wall.) Miers, Ann. Mag. Nat. Hist., II, 7 : 43. 1851; Diels, Pflanzenr., 46 (IV.94) : 214. 1910; Ridl., Fl. Malay Penin., 1 : 109. 1922.

Cocculus oblongus Wall., List, no. 4963. 1832 (*nomen nudum*).

SUMATRA, East Coast, Laboehan Batoe, Kota Pinang, Si Mandi Angin, on the Soengei Kanan, *Rahmat 4088*, April May, 1933. Malay Peninsula.

Cyclea acuminatissima Merrill, sp. nov.

Frutex gracilis, scandens, partibus junioribus inflorescentiisque parce pubescentibus exceptis glaber, caulibus teretibus, circiter 2 mm. diametro, obscure striatis, novellis leviter pubescentibus; foliis chartaceis, late lanceolatis vel anguste oblongo-ovatis, longe tenuiterque caudato-acuminatis, basi rotundatis, haud vel obscurissime cordatis, anguste peltatis, palmatim 7-nerviis, nervis binis exterioribus brevissimis, 8–12 cm. longis, 3–4.5 cm. latis, olivaceis, nitidis, utrinque subconcoloribus, supra glaberrimis, subtus ad nervos obscure pubescentibus, nervis primariis utrinque, supra basim, 2 vel 3, gracilibus, subtus elevatis; reticulis sublaxis, utrinque distinctis elevatisque; petiolo 2–3 cm. longo, glabro vel obscure pubescenti; inflorescentiis ♂ axillaribus vel subterminalibus, folia aequantibus vel longioribus, gracilibus, paniculatis, ramis primariis paucis, patulis, 4 5 cm. longis, distantibus, leviter pubescentibus, floribus in cymulis paucifloris, 3 4 mm. longis, subsessilibus vel breviter pedunculatis, in ramis primariis subracemose dispositis; floribus ♂ subcampanulatis, circiter 2.5 mm. longis, 1.7 mm. diametro, extus leviter pubescentibus, sepalis connatis, apice leviter 4-crenatis, deorsum angustatis; petalis connatis, corolla cyathiformi, glabra, 1 mm. longa; synandrii columella glabra, 1 mm. longa, corolla subaequilonga, antheris 4.

SUMATRA, East Coast, Asahan, Adian Rindang, near Hoeta Tomoean Dolok (Tomoean Dolok), *Rahmat 8935*, Nov. 17 to Dec. 10, 1935.

This species is apparently allied to *Cyclea elegans* King of the Malay Peninsula, differing in having paniculate inflorescences as

long as or longer than the leaves and in having narrower, slenderly caudate-acuminate leaves, longer and narrower staminate flowers, petals united into a cup, and calyx slightly crenate. Another close ally is *Cyclea caudata* Merr. of Borneo, which has the united petals of this Sumatran species, but its leaves are not peltate or are only very obscurely so, whereas the primary panicle branches are short and the flowers are much smaller than those of *C. acuminatissima* Merr.

ANNONACEAE

SAGERAEA ELLIPTICA (A. DC.) Hook. f. & Th., Fl. Ind., 93. 1855; King, Ann. Bot. Gard. Calcutta, 4:6, t. 34. 1893; Ridl., Fl. Malay Penin., 1:25. 1922.

Uvaria elliptica A. DC., Mém. Soc. Phys. Hist. Nat. Genève, 5:203. 1832. *Diospyros? frondosa* Wall., List, no. 4125. 1830 (*nomen nudum*).

SUMATRA, East Coast, Kota Pinang, Laboehan Batoe, Langga Pajoeng, *Rahmat 3430*, March 7–30, 1933; local name *kajoe toge*. Burma and Indo-China to the Malay Peninsula, Penang, and Borneo, and, if *S. glabra* Merr. be reduced, as it probably should be, also in the Philippines. *S. lanceolata* Miq., Ann. Mus. Bot. Lugd.-Bat., 2:10. 1865, type a Korthals specimen from Borneo, is probably not distinct. A sterile specimen is in the herbarium of the New York Botanical Garden. The genus is new to the records of Sumatra.

Drepananthus sumatranus Merrill, sp. nov.

Arbor circiter 10 m. alta, novellis dense ferrugineo-pubescentibus, ramis glabris, ramulis ultimis breviter subcastaneo-pubescentibus, circiter 2 mm. diametro; foliis ellipticis, coriaceis, 10–15 cm. longis, 5–7 cm. latis, apice late rotundatis vel acutis, basi rotundatis, siccis supra atrocastaneis, nitidis, glabris vel ad costam nervosque breviter ferrugineo-pubescentibus, subtus pallidioribus, brunneis, opacis, consperse breviter pubescentibus, nervis primariis utrinque circiter 10, subtus elevatis, perspicuis, circiter ad marginem curvato-anastomosantibus; petiolo pubescenti, 1 cm. longo; floribus in ramorum vetustiorium axillis defoliatis, binis vel solitariis; pedicellis circiter 5 mm. longis, dense breviter castaneo-pubescentibus; bracteolis ovatis, 1.5 mm. longis; calycis lobis late ovatis, circiter 4 mm. longis latisque, dense pubescentibus; petalis circiter 2 cm. longis, deorsum

ampliatis, concavis, conniventibus, partibus liberis subteretibus, circiter 1 mm. diametro, 1.8 cm. longis, dense breviter pubescentibus; carpellis circiter 5, dense villosis.

SUMATRA, East Coast, Bila, Aer Kandis, near Rantau Parapat, *Rahmat 2464*, May–June, 1932.

A species within a small genus characterized by its few-nerved rather small leaves and very narrow terete free portions of its petals. Its alliance is with *D. ramuliflorus* Maing. of the Malay Peninsula and Sumatra, but it differs vegetatively as well as by its few flowers. It seems to be even more closely allied to *D. carinatus* Ridl. of the Malay Peninsula.

FISSISTIGMA LANUGINOSUM (Wall.) Merr., Philip. Journ. Sci., 15 : 132. 1919.

Melodorum lanuginosum Hook. f. & Th., Fl. Ind., 117. 1855; King, Ann. Bot. Gard. Calcutta, 4 : 138, t. 182. 1923; Ridl., Fl. Malay Penin., 1 : 86. 1922. *Uvaria lanuginosa* Wall., List, no. 6472. 1832 (*nomen nudum*).

SUMATRA, Tapianoeli, Padang Si Dimpoean, Padang Lawas, Goenoeng Manaoen, *Rahmat 4460*, June, 1933; local name *andor lalap*. Indo-China, Malay Peninsula, Penang, Singapore.

Fissistigma longipes Merrill, sp. nov.

Frutex scandens, ramulis et inflorescentiis et (subtus) foliis, praesertim ad costam nervosque, dense breviterque subcastaneo- vel ferrugineo-tomentosis; ramulis teretibus, ultimis 2 mm. diametro; foliis ellipticis, chartaceis vel subcoriaceis, 10–12 cm. longis, 6–7 cm. latis, utrinque late rotundatis vel basi obscure cordatis, in siccitate brunneis, supra consperse breviter tomentosis, ad costam dense tomentosis, subtus pallidioribus, perspicue breviter tomentosis, nervis primariis utrinque circiter 13, subtus perspicuis, elevatis, juxta marginem curvato-anastomosantibus, secundariis distinctis, subparallelis; petiolo circiter 1 cm. longo, dense breviter subcastaneo-tomentoso; inflorescentiis axillaribus terminalibusque 7–10 cm. longis, paucifloris; pedicellis plerumque 2 vel 3, 3.5–5 cm. longis; floribus anguste pyramidatis, circiter 2.7 cm. longis; sepalis triangulari-ovatis, acutis vel obtusis, dense breviter pubescentibus, circiter 3 mm. longis; petalis exterioribus lanceolatis, 2.7 cm. longis, 5 mm. latis, coriaceis, sursum angustatis, obtusis, extus dense breviter subcastaneo-pubescentibus, interioribus simillimis sed quam exterioribus brevioribus

angustioribusque; antheris numerosis, 1.3 mm. longis; carpellis dense breviter ferrugineo-pubescentibus.

SUMATRA, East Coast, Asahan, near Haboko, *Rahmat 8449*, Oct. 20–29, 1935; local name *andor si maloem*.

A species of the section Pyramidanthe belonging in the group with *F. lanuginosum* (Wall.) Merr. and *F. Maingayi* (Hook. f. & Thoms.) Merr., but strongly characterized by unusually long pedicels.

XYLOPIA STENOPETALA Oliv., in Hook., Ic., 16, t. 1563. 1887; King, Ann. Bot. Gard. Calcutta, 4: 148, t. 194, f. A. 1893; Journ. As. Soc. Bengal, 61 (2): 118. 1892 (Mater. Fl. Malay. Penin., 1: 367).

SUMATRA, East Coast, Asahan, near Aek Moente, northeast of Tomoean Dolok, altitude about 500 m., *Rahmat 9269*, June–July, 1936; local name *kajoe banitan si marlilin*. Malay Peninsula.

Ridley, Fl. Malay Penin., 1: 92. 1922, erroneously credits this binomial to Hooker f. & Thomson; apparently his references are to *X. caudata* Hook. f. & Thoms., which he correctly cites on page 93.

MYRISTICACEAE

HORSFIELDIA TOMENTOSA Warb., Nova Acta Acad. Leop.-Carol. Nat. Cur., 68: 302. 1897; Ridl., Fl. Malay Penin., 3: 56. 1924.

Myristica tomentosa Hook. f. & Th., Fl. Ind., 161. 1855; Hook. f., Fl. Brit. Ind., 5: 105. 1886; A. DC., Prodr., 14 (1): 204. 1857; Miq., Fl. Ind. Bat., 1 (2): 68. 1858; King, Ann. Bot. Gard. Calcutta, 3: 301, t. 129. 1891, *non* Thunb., *nec* Blume.

SUMATRA, East Coast, Bila, Rantau Parapat, *Rahmat 2242*, May, 1922; Asahan, Silo Maradja, *Rahmat 801*, July Aug., 1926. Malay Peninsula, Penang, Singapore

Under Article 69 of the International Code the specific epithet *tomentosa* is valid in Horsfieldia, in spite of Thunberg's and Blume's earlier use of this same name in Myristica for an entirely different species, by the interpretation of Warburg's binomial *Horsfieldia tomentosa* as a new name.

Horsfieldia Bartlettii Merrill, sp. nov. § *Pyrrhosa, Eupyrrhosa.*

Arbor, inflorescentiis leviter subfurfuraceo-pubescentibus exceptis, glabra; ramis teretibus, ultimis 3 mm. diametro, verruculosis; foliis

coriaceis, oblongis, 18–25 cm. longis, 5.5–9 cm. latis, basi late acutis, apice subrotundatis, nervis primariis utrinque circiter 16, distinctis, elevatis, haud vel obscure arcuato-anastomosantibus, secundariis obsoletis; petiolo 1–1.5 cm. longo, margine involuto; inflorescentiis in axillis defoliatis, ♂ circiter 7 cm. longis, paniculatis, breviter pedunculatis, obscure subfurfuraceo-pubescentibus, ramis primariis paucis, 2 2.5 cm. longis; floribus glabris; alabastris pyriformibus, circiter 3 mm. longis, apice subrotundatis, deorsum angustatis; pedicellis crassis, alabastrum aequantibus, ebracteolatis; valvis 3 vel 4, late ovatis, subacutis, coriaceis, circiter 1.5 mm. longis, intus haud verrucosis; antheris paucis, omnino connatis; androecio sessili.

SUMATRA, East Coast, Asahan, Adian Rindang, *Rahmat 8772*, Nov. 17 to Dec. 10, 1935; local name *kajoe andorodong*.

The branches and leaves are entirely glabrous, strictly terete, without decurrent ridges, the evident lenticels causing the younger branchlets especially to be distinctly verruculose. The species is characterized by its narrowly pyriform staminate buds and flowers; the flowers are rounded at their apices and gradually narrowed below the middle to the stout pedicels, which equal the flowers in length.

LAURACEAE

LITSEA GRACILIPES Hook. f., Fl. Brit. Ind., 5: 159. 1886; Ridl., Fl. Malay Penin., 3: 130. 1924.

SUMATRA, East Coast, Laboehan Batoe, Kota Pinang, Si Mandi Angin, on the Soengei Kanan, *Rahmat 4006, 4026, 4135*, April May, 1933. Malay Peninsula, Borneo.

CAPPARIDACEAE

STIXIS PARVIFLORA (Griff.) Pierre, Bull. Soc. Linn Paris, 1: 655. 1887.

Roydsia parviflora Griff., Notul., 4: 578. 1854; Ic., t. 607, f. 1. 1854; Ridl., Fl. Malay Penin., 1: 120. 1922.

SUMATRA, East Coast, Asahan, near Loemban Ria, *Rahmat 7321, 7349, 7688*, Feb.–April, 1935; Simeloengoen, *Yates 1786*. Burma, Malay Peninsula. Apparently the genus is new to the records of Sumatra.

LEGUMINOSAE

BAUHINIA FLAMMIFERA Ridl., Journ. Straits Br. Roy. As. Soc., 82: 182. 1920; Fl. Malay Penin., 1: 631. 1922.

SUMATRA, East Coast, Bila, Laboehan Batoe, *Rahmat 4221*, May, 1933; Tapianoeli, Padang Si Dimpoean, Padang Lawas, *Rahmat 4653, 4954*, June–July, 1933; local name *andor si bola.* Malay Peninsula.

CRUDIA BANTAMENSIS (Hassk.) Benth., Trans. Linn. Soc., 25: 315. 1865; Koord. & Val., Meded. Lands Plantent., 14: 41. 1895 (Bijdr. Boomsoort. Java, 2: 41); Merr., Philip. Journ. Sci., 5: Bot. 39. 1910.

Touchiroa? bantamensis Hassk., Retzia, 1: 202. 1855.
Pryona bantamensis Miq., Fl. Ind. Bat., 1 (1): 1081. 1858.

SUMATRA, East Coast, Laboehan Batoe, Kota Pinang, Goenoeng Si Papan, *Rahmat 3863*, April, 1933; local name *kajoe banitan.* Java, Borneo.

Recorded here to call attention again to the fact that Bentham made the transfer in 1865, long before either Koorders and Valeton, or I did, but his binomial escaped notice by the compilers of the Index Kewensis.

CROTALARIA USARAMOENSIS E. G. Baker, Journ. Linn. Soc. Bot., 42: 346. 1914; Backer & Van Slooten, Geillustr. Handb. Jav. Theeonkr., 132, t. 132. 1924; Backer, Onkruidfl. Jav. Suikerreitgr., 291. 1930.

SUMATRA, East Coast, Karoland, Dĕlĕng Singkoet, Asahan, and Haboko, *Rahmat 645, 8414, 8448*, June, 1928, and Oct., 1935; local names *oper, koroan.* Native of Tanganyika Territory, Africa, introduced into Java in 1916.

CROTALARIA ANAGYROIDES HBK., Nov. Gen. Sp. Pl., 6: 404. 1823; Backer & Van Slooten, Geillustr. Handb. Jav. Theeonkr., 128, t. 128. 1924; Backer, Onkruidfl. Jav. Suikerrietgr., 292. 1930.

SUMATRA, East Coast, Asahan, Hoeta Padang, and Haboko, *Rahmat 940, 8415*, May, 1928, and Oct., 1935; local names *harison, kajoe hisik-hisik.* Native of tropical America, introduced into Java in 1919.

DUNBARIA SCORTECHINII Prain, Journ. As. Soc. Bengal, 66 (2): 44. 1897 (King, Mater. Fl. Malay. Penin., 3: 44); Ridl., Fl. Malay Penin., 1: 563. 1922.

SUMATRA, East Coast, Bila, near Rantau Parapat, *Rahmat 2054, 2345*, May, 1932. Malay Peninsula, Hainan. The genus is new to the records of Sumatra.

Rhynchosia sumatrana Merrill, sp. nov.

Scandens, ramis teretibus, striatis, consperse pilosis; foliis trifoliolatis; petiolo 5 6 cm. longo, consperse ciliato-piloso; foliolis submembranaceis, ovatis, perspicue subcaudato-acuminatis, 9–15 cm. longis, 5 9 cm. latis, siccis supra subolivaceis, consperse pubescentibus, subtus pallidioribus, molliter consperse ciliato-pilosis, haud glandulosis, basi trinerviis, terminali symmetro, basi rotundato, lateralibus asymmetris; nervis utrinque circiter 6, gracilibus, distinctis, subtus elevatis; petiolulis dense pubescentibus, 3 mm. longis; racemis axillaribus, infructescentibus circiter 10 cm. longis, dense pubescentibus; calycibus persistentibus pilosis; leguminibus 2-2.5 cm. longis, 7–8 mm. latis, deorsum angustatis; valvis subcontortis, extus dense molliter subgriseo-pubescentibus; seminibus nigris, subcompressis, rotundatis, circiter 6 mm. diametro.

SUMATRA, East Coast, Bila, near Rantau Parapat, *Rahmat 2028*, March 28 to May 10, 1932.

Apparently the first representative of the genus to be recorded from Sumatra. Its alliance seems to be with *R. calosperma* Warb.

OXALIDACEAE

SARCOTHECA SUBTRIPLINERVIS Hall. f., Beih. Bot. Centralbl., 34 (2): 27. 1916.

SUMATRA, East Coast, Asahan, Hoeta Padang, *Krukoff 288, 4383*, Dec., 1930, and Nov., 1932, in primary forests. Borneo.

RUTACEAE

ZANTHOXYLUM MYRIACANTHUM Wall., List, no. 1214. 1829 (*nomen nudum*); Hook. f., Fl. Brit. Ind., 1: 496. 1875; Ridl., Fl. Malay Penin., 1: 347. 1922.

SUMATRA, East Coast, Asahan, near Aek Moente, northeast of Tomoean Dolok, *Rahmat 9383*, June, 1936; local name *kajoe radjo-radjo*. Malay Peninsula, Penang.

Evodia Krukovii Merrill, sp. nov.

Arbor circiter 15 m. alta, ramulis novellis inflorescentiisque exceptis, glabra; ramis crassis, subteretibus vel leviter compressis, glabris vel obscure puberulis, ramulis ultimis subcinereo-puberulis, plus minusve compressis, 3–5 mm. diametro; foliis 3-foliolatis, petiolo 4–7 cm. longo, puberulo, foliolis crasse coriaceis, ellipticis vel obovatis, supra olivaceis vel pallide olivaceis, glaberrimis, subtus pallidioribus, glabris vel secus costam nervosque obscure puberulis, 7–15 cm. longis, 3–9 cm. latis, apice late rotundatis vel obtusis, rare retusis, basi late acutis; nervis primariis utrinque plerumque 8–10, rare 12–14, subtus elevatis, valde perspicuis, supra planis vel leviter impressis; petiolulis 4–8 mm. longis, puberulis; cymis plerumque longe (4–12 cm.) pedunculatis, puberulis, multifloris, 8–15 cm. latis; floribus 4-meris, in ramulis ultimis subcapitatim confertis, pedicellis puberulis, circiter 1–2 mm. longis; sepalis ovatis, circiter 0.8 mm. longis; petalis oblongo-ellipticis, acutis vel obtusis, glabris, maturis reflexis, 2.5–3 mm. longis, filamentis 2.5 mm. longis, antheris oblongo-ellipticis, 1.2 mm. longis; ovario densissime pallide pubescenti; stylis circiter 1 mm. longis, deorsum pubescentibus, sursum glabris.

SUMATRA, East Coast, Asahan, Hoeta Padang, *B. A. Krukoff 4315* (type), Nov. 21, 1932; Loemban Ria, *Rahmat 8011*, *8085*, Feb.–April, 1934; near Aek Moente, northeast of Tomoean Dolok, *Rahmat 9260*, June, 1936; Bila, Rantau Parapat, *Rahmat 2253*, May 18, 1932; local names *kajoe modang tandoek, kajoe modang si tiga daoen, kajoe modang si toloe boeloeng*.

Among the species with very coriaceous, elliptic to obovate, usually rounded leaflets, this is characterized by very prominent elevated lateral nerves, usually elongated peduncles, subcinereous, short, puberulous indumentum, and numerous flowers crowded in subcapitate masses on the ultimate branchlets. Some of the specimens were originally referred to the Javan *Evodia nervosa* Koord. & Val., but this Sumatran plant is clearly not the same as that species.

MELIACEAE

AGLAIA MATTHEWSII Merr., Philip. Journ. Sci., 13: Bot. 79. 1918; Univ. Calif. Publ. Bot., 15: 124. 1929.

SUMATRA, East Coast, Laboehan Batoe, Kota Pinang, *Rahmat 4197*, April–May, 1933; local name *kajoe piran*. Borneo.

EUPHORBIACEAE

ACALYPHA SIAMENSIS Oliv., ex Gage, Rec. Bot. Surv. India, 9: 238. 1922; Ridl., Fl. Malay Penin., 3: 274. 1924.

Acalypha Evrardii Gagnep., Bull. Soc. Bot. France, 70: 871. Feb. 28, 1923; Lecomte, Fl. Gén. Indo-Chine, 5: 336. 1925

SUMATRA, East Coast, Bila, near Rantau Parapat, *Rahmat 1848*, March–July, 1935; Asahan, near Aer Djoman, east of Serbangan, *Rahmat 8238*, *8270*, May, 1932; local names *kajoe sahi*, *kajoe pala*, *kajoe tes*. Tenasserim, Siam, Indo-China, and the Malay Peninsula.

APOROSA BENTHAMIANA Hook. f., Ic., 16, t. 1583. 1887; Pax & Hoffm. Pflanzenr., 81 (IV.147.XV): 84. 1922; Ridl., Fl. Malay Penin., 3: 236. 1924.

SUMATRA, East Coast, Asahan, near Loemban Ria, *Rahmat 7681*, Feb. 5 to April 12, 1934; local name *kajoe dara*. Malay Peninsula.

BRIDELIA PUBESCENS Kurz, Journ. As. Soc. Bengal, 42 (2): 241. 1873; Jabl., Pflanzenr., 65 (IV.147.VIII): 73. 1915.

SUMATRA, East Coast, Asahan, Silo Maradja, near Taloen Djoring, *Rahmat 833*, July–Aug., 1928. Himalayan region, eastern Bengal, Burma, Yunnan, and ? Formosa.

BRIDELIA RETUSA Spreng., Syst., 3: 48. 1826; Jabl., Pflanzenr., 65 (IV.147.VIII): 69. 1915; Ridl., Fl. Malay Penin., 3: 184. 1924.

SUMATRA, Tapianoeli, Padang Si Dimpoean, Padang Lawas, *Rahmat 4373*, May, 1933. India and Ceylon to Burma, Siam, and the Malay Peninsula.

BRIDELIA GLAUCA Blume, Bijdr., 597. 1925; Jabl., Pflanzenr., 65 (IV.147.VIII): 74. 1915.

SUMATRA, Tapianoeli, Padang Si Dimpoean, Padang Lawas, *Rahmat 4640*, June, 1933; Asahan, near Loemban Ria, *Rahmat 7657*, Feb. 5 to April 12, 1934; local name *kajoe samodja boenga*. Java, Borneo, and the Philippines.

It is suspected that this is the Malay Peninsula form referred by Ridley and others to *B. ovata* Decne., the type of which was from Timor.

LONGETIA MALAYANA (Benth.) Pax & Hoffm., Pflanzenr., 81 (IV.147.XV): 291. 1922; Ridl., Fl. Malay Penin., 3: 224. 1924.

Choriophyllum malayanum Benth., Hook., Ic., 13, t. 1280. 1879.

SUMATRA, East Coast, Asahan, near Loemban Ria, *Rahmat 7983*, Feb.-April, 1935; local name *kajoe handis rata*. Malay Peninsula, Penang, and Borneo. The genus is new to the records of Sumatra.

MALLOTUS BARBATUS (Wall.) Muell.-Arg., Linnaea, 34: 184. 1865; Pax & Hoffm., Pflanzenr., 63 (IV.147.VII): 164, f. 24. 1914.

Rottlera barbata Wall., List, no. 7822. 1847 (*nomen nudum*).

SUMATRA, East Coast, Laboehan Batoe, Kota Pinang, Si Mandi Angin, *Rahmat 3973*, *4179*, April-May, 1933; local name *bittoeroe*. India to southern China, Indo-China, Malay Peninsula, Penang, and Java.

MALLOTUS MORITZIANUS Muell.-Arg., in DC., Prodr., 15 (2): 971. 1866; Pax & Hoffm., Pflanzenr., 63 (IV.147.VII): 152. 1914.

SUMATRA, East Coast, Asahan, Silo Maradja, near Taloen Djoring, *Rahmat 840*, July-Aug., 1928. Java, Borneo.

MALLOTUS KORTHALSII Muell.-Arg., in DC., Prodr., 15 (2): 976. 1866; Pax & Hoffm., Pflanzenr., 63 (IV.147.VII): 158. 1914.

Rottlera Korthalsii Scheff., in Miq., Ann. Mus. Bot. Lugd.-Bat., 4: 124. 1868.

SUMATRA, East Coast, Laboehan Batoe, Kota Pinang, *Rahmat 3784*, *4338*, April-May, 1933; Tapianoeli, Padang Si Dimpoean, Padang Lawas, *Rahmat 4510*, June, 1933. Borneo, Philippines.

PTEROCOCCUS CORNICULATUS (Smith) Pax & Hoffm., Pflanzenr., 68 (IV.147.IX-XI): 22. 1919.

Plukenetia corniculata Smith, Nova Acta Soc. Sci. Upsal., 6: 4. 1799, Merr., Interpret. Herb. Amb., 323. 1917.

Pterococcus glaberrimus Hassk., Flora, 25: Beibl., 41. 1842; Ridl., Fl. Malay Penin., 3: 309. 1924.

SUMATRA, East Coast, Laboehan Batoe, Kota Pinang, *Rahmat 3948*, April May, 1933. India to the Malay Peninsula, Java, Borneo, the Philippines, and the Moluccas.

The generic name Pterococcus Hassk. (1842) is preoccupied by Pterococcus Palla (1776), which is a synonym of Calligonium Linn. If Hasskarl's generic designation is to be retained for this group it needs to be placed in the list of conserved names. It is included in the list of later generic homonyms; *Kew Bull.*, 454. 1935.

Sphaerostylis glabrata (Kurz), comb. nov.

Cnesmone glabrata Kurz, Flora, 58: 31. 1875.
Megistostigma malaccense Hook. f., Ic., 16: t 1592. 1887.
Sphaerostylis malaccensis Pax & Hoffm., Pflanzenr, 68 (IV.147.IX–XI): 107, f. 11 E, F. 1919. Ridl., Fl. Malay Penin., 3: 308. 1924

SUMATRA, East Coast, Bila, near Rantau Parapat, *Rahmat 1975*, March–May, 1932; Damoeli, Koealoe, *Rahmat 1389*, Sept., 1928; Laboehan Batoe, Kota Pinang, *Rahmat 4332*, May, 1933; Hoeta Bagasan, *Rahmat 7186*, Sept., 1934, to Feb., 1935; Tomoean Dolok, *Rahmat 9864*, Aug., 1936; local name *latong andor*. Malay Peninsula. A genus new to the records of Sumatra.

Kurz's type was from Singapore, and his description applies unmistakably to the species, described in 1887 by Hooker f. as the type of a new genus, Megistostigma. A second species, *S. cordata* (Merr.) Pax & Hoffm., occurs in the Philippines.

Cleistanthus euphlebius Merrill, sp. nov. § *Leiopyxis*.

Arbor parva, monoica, ramis ramulisque glabris; foliis oblongis, oblongo-ovatis vel subellipticis, 10 18 cm. longis, 3.5–6.5 cm. latis, graciliter acuminatis, basi acutis vel late acutis, subcoriaceis, siccis supra pallidis, nitidis, subtus pallide subcupreis, minutissime obscurissime puberulis, nervis primariis utrinque 7 8, subtus elevatis, valde perspicuis, curvato-ascendentibus, ad marginem obscure anastomosantibus, secundariis subparallelis, gracilibus, obscuris; petiolo glabro, rugoso, 5–8 mm. longo; stipulis caducis; glomerulis in ramulis pubescentibus efoliatis 5–9 cm. longis dispositis, 5–15 mm. distantibus; floribus sessilibus, 5-meris, glabris, ♂ 5 mm. diametro, sepalis oblongis, acutis, 2 2.5 mm. longis; petalis triangulari-sagittatis, acutis, 1 mm. longis; androphoro glabro, 1 mm. longo, filamentis 1.5 mm. longis; ovarii rudimento anguste ovoideo, glabro, 3-lobato, 1 mm. longo; ♀ 7 mm. diametro; sepalis oblongo-ovatis,

acutis vel acuminatis, 3 mm. longis; petalis triangulari-ovatis, acutis, haud spathulatis, deorsum angustatis, 1.3 mm. longis; disco cupuliformi, submembranaceo, 1.5 mm. alto, irregulariter dentato; ovario ferrugineo-hirsuto, subgloboso, 2 mm. diametro; stylis 3, bifidis, circiter 1.5 mm. longis.

SUMATRA, East Coast, Asahan, Silo Maradja, near Taloen Djoring, *Rahmat 818* (type), *832*, July–Aug., 1928, merely indicated as a tree.

A species characterized by slenderly caudate-acuminate, prominently nerved leaves and by glomerules being scattered on elongated, pubescent, leafless branches; the inflorescence is really a spike of glomerules, which are 0.5 to 1.5 cm. apart. From Jablonszky's arrangement of the species it is suspected that its alliance is with the Bornean *C. laevigatus* Jabl.

CELASTRACEAE

MICROTROPIS FILIFORMIS King, Journ. As. Soc. Bengal, 65 (2) : 342. 1896 (Mater. Fl. Malay. Penin., 2 : 628); Ridl., Fl. Malay Penin., 1 : 444. 1922.

SUMATRA, East Coast, Koeloe, Loendoet Concession, near Aek Sordang, *Bartlett 7653*, May 10, 1927; Asahan, Hoeta Padang, *Krukoff 4427*, Dec. 5, 1932, in secondary forests; near Loemban Ria, *Rahmat 7886*, Feb. 5 to April 12, 1935; local name *kajoe borhoem*. Siam, Burma, Tenasserim, and the Malay Peninsula.

STACKHOUSIACEAE

STACKHOUSIA INTERMEDIA F. M. Bailey, Queensl. Agric. Journ., 3 : 281. 1898. forma PHILIPPINENSIS Pamp., Bull. Herb. Boiss., II, 5 : 1150. 1905.

SUMATRA, East Coast, various localities in Bila, Kota Pinang, and Padang Si Dimpoean, *Rahmat 1882*, *2475*, *2517*, *2657*, *3316*, *3463*, *3533*, *4154*, *4227*, *4974*, March, 1932, to July, 1933.

The Sumatran form of this Australian type very closely approximates the Philippine one, now known from various localities in the Philippines (one collection recently examined being *Haenke 606*, Sorsogon, Luzon, 1792, its earliest collection outside Australia), Amboina, and the Pelew Islands (*Kanehira 442*, *2106*, *2382*; *Herre 61*). The typical form of the species occurs in Australia.

STAPHYLEACEAE

TURPINIA LAXIFLORA Ridl., Journ. Roy. As. Soc. Straits Branch, 82: 179. 1920; Fl. Malay Penin., 1: 512. 1922.

SUMATRA, East Coast, Asahan, near Hoeta Bagasan, *Rahmat 6689, 6894, 7198*, Sept., 1934, to Feb., 1935; local names *kajoe songgak, kajoe longgahon*. Malay Peninsula.

This seems clearly to represent the form that Ridley described from the Malay Peninsula. The Malaysian forms of this genus are badly in need of revision, since several have been confused with Indian species that do not extend to the Archipelago.

SABIACEAE

Meliosma trichocarpa Merrill, sp. nov. § *Pinnatae*.

Arbor, partibus junioribus, inflorescentiis, et (subtus) foliolis, praesertim ad costam nervosque, subferrugineo- vel subcastaneo-villosis; foliis pinnatis, 15–30 cm. longis, foliolis 9–11, integerrimis, firmiter chartaceis vel subcoriaceis, 7 12 cm. longis, 3–5 cm. (vel terminalibus usque ad 6 cm.) latis, oblongo-ellipticis vel terminalibus oblongo-obovatis, acuminatis, basi acutis, supra olivaceis, nitidis, costa excepta glabris, subtus pallidioribus, ad costam nervosque subferrugineo-villosis, nervis primariis utrinque circiter 8, subtus elevatis, perspicuis, arcuato-anastomosantibus, reticulis sublaxis; petiolulis pubescentibus, 2 3 mm. longis; paniculis terminalibus, erectis, multifloris, folia subaequantibus, pubescentibus; ramis inferioribus usque ad 15 cm. longis; superioribus brevioribus; floribus numerosis, sessilibus, in ramulis ultimis spicatim dispositis, haud glomeratis; sepalis ovatis, obtusis, circiter 2 mm. longis, margine leviter ciliatis; petalis staminibusque ignotis; ovario dense pubescenti; fructibus subellipsoideo-ovoideis vel subovoideo-globosis, paulo inaequilateralibus, siccis minute verruculosis, circiter 8 mm. longis, perspicue consperseque crispatulo-pubescentibus.

SUMATRA, East Coast, Asahan, near Aek Moente (Aer Moette), northeast of Tomoean Dolok, *Rahmat 9319* (type), June–July, 1936; local name *kajoe si mardjochoet ni manoek;* near Loemban Ria, *Rahmat 7930*, Feb.-April, 1934. The species is apparently represented also by *Rahmat 6848, 7505, 9210*, from Hoeta Bagasan,

Loemban Ria, and Aek Moente, but my specimens are rather fragmentary.

In general, this species resembles certain specimens referred, correctly or incorrectly, to *Meliosma Wallichii* Planch., but in the Sumatran plant the leaflets are strictly entire and very sharply acuminate, and the flowers are sessile. The most striking differential character of the present species is its distinctly pubescent fruits; those of most of the other allied species are glabrous.

ELAEOCARPACEAE

ELAEOCARPUS MASTERSII King, Journ. As. Soc. Bengal, 60 (2) : 140. 1891 (Mater. Fl. Malay. Penin., 1 : 249); Ridl., Fl. Malay Penin., 1 : 319. 1922.

SUMATRA, East Coast, Kota Pinang, Laboehan Batoe, *Rahmat 3885*, *4005*, April–May, 1933; local name *kajoe sikoroe*. Malay Peninsula.

TILIACEAE

Microcos impressinervia Merrill, sp. nov.

Arbor parva, ramis teretibus, glabris, ultimis breviter pubescentibus, 2 mm. diametro; foliis coriaceis, oblongo-ovatis vel oblongis, integerrimis, acuminatis, basi subrotundatis, perspicue 3-nerviis, 7–10 cm. longis, 3–4 cm. latis, rigidis, supra glabris vel ad costam leviter pubescentibus, pallide olivaceis, nitidis, subtus pallidioribus, praesertim ad costam nervosque plus minusve stellato-pubescentibus, nervis primariis utrinque circiter 5, distantibus, superne sicut costa impressis, subtus perspicuis, elevatis, secundariis gracilibus, subparallelis, distinctis; petiolo circiter 8 mm. longo, dense breviter pubescenti, glabrescenti; fructibus pyriformibus, glabris, pallidis, nitidis, circiter 2 cm. longis.

SUMATRA, Tapianoeli, Padang Si Dimpoean, Padang Lawas (topographic sheet 41, northwest corner), *Rahmat 4467*, May 31 to June 19, 1933.

Recognizable in the group of entire-leaved species to which it belongs by its small, prominently acuminate, coriaceous, rather stiff leaves, the nerves and midrib impressed on the upper surface, strongly elevated beneath. Closely allied to *Microcos calophylla* (Kurz) Burret, as originally described from Andaman Islands material, but

differing not only in its midrib and lateral nerves being strongly impressed on the upper surface, but also in the conspicuous secondary nerves on the lower surface of its leaves.

RHIZOPHORACEAE

PALLACALYX SACCARDIANUS Scort., Nuovo Giorn. Bot. Ital., 17: 143. 1885; Hemsl., Hook., Ic., 16, t. 1546. 1886; King, Journ. As. Soc. Bengal, 66(2): 321. 1897 (Mater. Fl. Malay. Penin., 3: 321); Ridl., Fl. Malay Penin., 1: 699, f. 62. 1922.

SUMATRA, East Coast, Hoeta Padang, *Krukoff 4282, 4354*, Nov., 1932, in secondary forests; Asahan, near Loemban Ria, *Rahmat 7527*, Feb.–April, 1935; local name *kajoe boehoe-boehoe*. Malay Peninsula.

COMBRETACEAE

COMBRETUM SQUAMOSUM Roxb., Hort. Bengal, 88. 1814 (*nomen nudum*); G. Don, Trans. Linn. Soc., 15: 438. 1827; Roxb., Fl. Ind., ed. 2, 2: 231. 1832; Ridl., Fl. Malay Penin., 1: 709. 1922.

SUMATRA, East Coast, Laboehan Batoe, Kota Pinang, Si Mandi Angin, *Rahmat 3951*, April-May, 1923. India to Burma, Hainan, Andaman Islands, Malay Peninsula, Borneo, and the Philippines.

MYRTACEAE

EUGENIA BRACTEOLATA Wight, Ill., 2: 15. 1841; Duthie, in Hook. f., Fl. Brit. Ind., 2: 488. 1878; King, Journ. As. Soc. Bengal, 70(2): 122. 1901 (Mater. Fl. Malay. Penin., 3: 552); Ridl., Fl. Malay Penin., 1: 747. 1922.

SUMATRA, East Coast, Asahan, near Hoeta Bagasan, *Rahmat 7255*, Sept., 1934, to Feb., 1935; local name *kajoe haoendolok;* Hoeta Padang, *Krukoff 4398*, Nov. 30, 1932, in secondary forests. Malay Peninsula and the Andaman Islands.

EUGENIA CURTISII King, Journ. As. Soc. Bengal, 70(2): 129. 1901 (Mater. Fl. Malay. Penin., 3: 559); Ridl., Fl. Malay Penin., 1: 749. 1922.

Eugenia coralina Merr., Journ. Straits Branch Roy. As. Soc., 77: 207. 1917; *op. cit.*, 79: 20. 1918; *op. cit.*, Special No. 427. 1921.

SUMATRA, East Coast, Sigamata, near Rantau Parapat, *Rahmat 3241*, June–July, 1932; local name *kajoe rima-rima*. Malay Peninsula and, with the reduction of *E. coralina* Merr., also in Borneo.

EUGENIA MUELLERI Miq., Anal. Bot. Ind., 1 : 23, t. 6. 1850; Merr., Journ. Straits Branch Roy. As. Soc., Special No. 431. 1921.

Syzygium obovatum Korth., Nederl. Krukdk. Arch., 1 : 205. 1848, *non* DC.
Syzygium Muelleri Miq., Fl. Ind. Bat., 1 (1) : 453. 1855.

SUMATRA, East Coast, Asahan, Hoeta Padang, *Krukoff 4396*, Nov. 30, 1932, in primary forests. Borneo.

EUGENIA CHLOROLEUCA King, Journ. As. Soc. Bengal, 70 (2) : 113. 1901 (Mater. Fl. Malay. Penin., 3 : 543); Ridl., Fl. Malay Penin., 1 : 744. 1922.

SUMATRA, East Coast, Asahan, Masihi Forest Reserve, *Krukoff 4116*, Oct. 19, 1932, local name *djamboe dolok;* near Hoeta Bagasan and Loemban Ria, *Rahmat 6996, 7804, 8107*, local names *kajoe raroe tombak, kajoe raroe, kajoe tamba toeran;* Dolok Maradja, *Rahmat 1469*, Oct., 1928; Koeloe, Damoeli, *Rahmat 254*, Feb. March, 1928; Tapianoeli, between Toetoepan and Si Makkoek, along the Toba trail, *Bartlett 7536*, April 21 25, 1927. Malay Peninsula.

MELASTOMATACEAE

Melastoma stenophyllum Merrill, sp. nov.

Frutex erectus, ramis vetustioribus glabris; ramulis teretibus, dense adpresse paleaceis, ultimis circiter 1 mm. diametro; foliis numerosis, 3-nerviis, lanceolatis vel anguste lanceolatis, 5 10 cm. longis, 5–15 mm. latis, coriaceis vel subcoriaceis, sursum angustatis, obscure acuminatis vel acutis, basi plerumque acutis, siccis supra viridibus vel olivaceis, densissime peradpresse strigosis, haud scabris, subtus pallidioribus, dense adpresse strigosis, ad costam nervosque adpresse paleaceis, nervis longitudinalibus supra valde impressis, subtus elevatis, perspicuis; nervis horizontalibus reticulisque obsoletis; petiolo dense adpresse paleaceo, 5–8 mm. longo; floribus terminalibus, sessilibus vel breviter pedicellatis, plerumque solitariis, rare binis, 5-meris, ebracteolatis vel basi bracteolis binis lanceolatis anguste lanceolatis dense adpresse paleaceis subtentis; calycibus

extus dense adpresse paleaceis, paleis pallide brunneis, circiter 1 mm. longis, tubo 8–10 mm. longo, lobis lanceolatis, acuminatis, tubum aequantibus, dentibus alternis minutis vel nullis; petalis obovatis, circiter 2 cm. longis, rotundatis, margine obscure breviterque ciliatis; antheris majoribus circiter 7 mm. longis.

SUMATRA, East Coast, Asahan, near Bandar Poeloe, *Bartlett 6624*, Feb., 1927; near Hoeta Bagasan, *Rahmat 6626*, *7000* (type), Sept. 7, 1934, to Feb. 4, 1935; near Aek Salabat, *Rahmat 9610*, July, 1936; local name *sandoelock batoe*.

A very strongly marked species not closely allied to any previously described form, although belonging in the group with *Melastoma polyanthum* Blume. It is characterized not only by very narrow, prominently 3-nerved leaves, but also by usually solitary flowers.

Blastus sumatranus Merrill, sp. nov.

Frutex erectus, ramulis, petiolis, inflorescentiis, et subtus foliis ad costam nervosque interiores plumoso-pubescentibus; foliis membranaceis vel chartaceis, oblongo-ovatis vel late oblongo-lanceolatis, 22–30 cm. longis, 6–8 cm. latis, subcaudato-acuminatis, basi late acutis, 5-nerviis, nervis submarginalibus glabris, supra olivaceis, glabris, subtus pallidioribus multiglandulosis, glandulis flavidis; nervis exterioribus glabris, interioribus et costa pallide plumoso-pubescentibus; petiolo 2 cm. longo, plumoso-pubescenti; paniculis terminalibus, 2–3 cm. longis, plumoso-pubescentibus; fructibus ovoideis, 2–3 mm. longis, subflavido-glandulosis.

SUMATRA, Tapianoeli, Padang Si Dimpoean, Padang Lawas, Aek Kanan (topographic sheet 41, northwest corner), *Rahmat 4803*, July 1–2, 1933.

Allied to *Blastus Cogniauxii* Stapf., but with much larger leaves; differing also in the plumose indumentum of the branchlets, petioles, inflorescences, midrib, and the two interior nerves beneath, the outer submarginal ones being glabrous.

Medinilla acrochordonocarpa Merrill, nom. nov.

Medinilla verrucosa Baker f., Journ. Bot., 62: Suppl. 41. 1924, *non* Blume.

The type of Baker's species is *Forbes 2292a* from Mount Dempo, Sumatra; his specific name is invalidated by that of Blume.

Medinilla Ridleyi Merrill, nom. nov.

Medinilla vulcanica Ridl., Journ. Malay Branch Roy. As. Soc., 1: 61. 1923; Merr., Contrib. Arnold Arb., 8: 115. 1934, *non* Merrill, 1917.

The type of Ridley's species was from Sibajak Volcano, Sumatra; the species is also represented by *Yates 1423, 1977, 2279, Bangham 1032*, and *Bartlett 6570, 8000*. A new name is proposed for it, since I had published the same binomial for a very different Philippine species in 1917.

Anplectrum crassinodum Merrill, sp. nov.

Frutex scandens, glaber, ramis teretibus, ramulis brunneis subcompressis, ultimis circiter 1.5 mm. diametro; nodis incrassatis; internodiis circiter 5 cm. longis; foliis oppositis, oblongis vel latissime oblongo-lanceolatis, coriaceis, circiter 10 cm. longis, 4 cm. latis, basi rotundatis vel latissime obtusis, 5-nerviis, apice caudato-acuminatis, acumine circiter 1 cm. longo, supra nitidis, olivaceis, subtus paulo pallidioribus vel brunneis, utrinque glabris; costa nervisque supra impressis, subtus elevatis, interioribus perspicuis, exterioribus submarginalibus, gracilibus, nervulis horizontalibus gracilibus distinctis; petiolo 5–7 mm. longo, glabro; paniculis axillaribus terminalibusque, glabris vel partibus junioribus minutissime obscureque puberulis, pedunculatis, 8–12 cm. longis; floribus 4-meris, pedicellis 4–6 mm. longis; calycibus cylindraceis, 6–7 mm. longis, circiter 4 mm. diametro, junioribus truncatis, vetustioribus obscure irregulariter lobatis, sub lente minute puncticulatis; petalis late ellipticis, circiter 6 mm. longis et 5 mm. latis; staminibus 8, valde inaequalibus; 4 majoribus fertilibus, filamentis 6 mm. longis, antheris sigmoideis, acuminatis, filamenta aequantibus, connectivo postice brevissime calcarato; 4 minoribus sterilibus, filamentis 4 mm. longis, antheris rudimentariis filiformibus, 6 mm. longis; stylis 13 mm. longis.

SUMATRA, East Coast, Asahan, near Loemban Ria, *Rahmat 7781*, Feb. 5 to April 12, 1934.

The outer nerves are about 1 mm. within the margin and are much slenderer than the interior ones and the midrib. The undeveloped anthers of the four smaller stamens are filiform, much slenderer than their filaments, in striking contrast to the four larger fertile ones. Its alliance seems clearly to be with *A. glaucum* (Jack) Triana.

OCHTOCHARIS BORNEENSIS Blume, Mus. Bot. Lugd.-Bat., 1 : 40. 1849; Cogn., in DC., Monog. Phan., 7 : 480. 1891; Hallier f., Ann. Jard. Bot. Buitenzorg, 13 : 283, t. 21. 1896; Ridl., Fl. Malay Penin., 1 : 775. 1922.

SUMATRA, East Coast, Laboehan Batoe, Kota Pinang, Goenoeng Si Papan, *Rahmat 3868*, April, 1933. Malay Peninsula, Borneo, and New Guinea. The Sumatra form has rather large leaves, up to 18 cm. long and 8 cm. wide.

MYRSINACEAE

EMBELIA CANESCENS Jack, in Roxb., Fl. Ind., 2 : 292. 1824; Mez, Pflanzenr., 9 (IV.236) : 305. 1902; Ridl., Fl. Malay Penin., 2 : 232. 1923.

SUMATRA, East Coast, Asahan, Loemban Ria, *Rahmat 7634*, Feb. 5 to April 12, 1934. Penang, Malay Peninsula.

LOGANIACEAE

GARDNERIA OVATA Wall., in Roxb., Fl. Ind., 1 : 400. 1820; Pl. As. Rar., 3 : 17, t. 231. 1832; Cammerl., Bull. Jard. Bot. Buitenz., III, 5 : 305. 1923.

SUMATRA, East Coast, Asahan, near Haboko, *Rahmat 8453*, Oct., 1935. India to Java; but no representative of the genus is recorded from the Malay Peninsula.

SPIGELIA ANTHELMIA Linn., Sp. Pl., 149. 1753; Koord., Exkursionsfl. Java, 3 : 57. 1912; Cammerl., Bull. Jard. Bot. Buitenz., III, 5 : 298. 1923; Backer, Onkruidfl. Jav. Suikerrietgr., 484. 1931.

SUMATRA, East Coast, Asahan, near Haboko, *Rahmat 8401;* local name *sammondjo.* A native of tropical America, introduced into Java in 1845; apparently of recent introduction into Sumatra.

APOCYNACEAE

VOACANGA FOETIDA (Blume) Rolfe, Journ. Bot., 21 : 202. 1883; Baill., Hist. Pl., 10 : 171. 1891; K. Schum., in Engl. u. Prantl, Nat. Pflanzenfam., 4 (2) : 149. 1895.

Orchipeda foetida Blume, Bijdr., 1027. 1826.

SUMATRA, East Coast, Sibolangit, *Yates 1586;* near Prapat, Simeloengoen, *Yates 2178;* Tapianoeli, Padang Si Dimpoean, Padang Lawas, Sopsopan, on Aek Si Olip, *Rahmat 5477*, Sept. 4–10, 1933. Java.

Rolfe, Baillon, and K. Schumann independently transferred Blume's specific name from Orchipeda to Voacanga; Rolfe's treatment was the earliest.

CHILOCARPUS DECIPIENS Hook. f., Fl. Brit. Ind., 3: 627. 1882; King, Journ. As. Soc. Bengal, 74 (2) : 402. 1907 (Mater. Fl. Malay. Penin., 4 : 612); Ridl., Fl. Malay Penin., 2 : 327. 1923.

SUMATRA, East Coast, Bila, Kota Pinang, and Simeloengoen, *Rahmat 1428, 2632, 3927, 3979, 4010, 4181*, Sept., 1928, to May, 1933; local name *andor pipiran*. Malay Peninsula.

LEUCONOTIS MAINGAYI Dyer, in Hook. f., Fl. Brit. Ind., 3 : 628. 1882; Ridl., Fl. Malay Penin., 2 : 329. 1923.

SUMATRA, East Coast, Asahan, Adian Rindang, *Rahmat 8886*, Nov. Dec., 1935. Malay Peninsula, Borneo.

Tabernaemontana pubituba Merrill, sp. nov.

Frutex vel arbor parva, inflorescentiis floribusque exceptis glabra, ramis teretibus, ramulis ultimis circiter 2 mm. diametro; foliis in paribus paulo inaequalibus, chartaceis, siccis utrinque minute verruculosis, supra olivaceis, subtus concoloribus vel paulo pallidioribus, oblongis, 10–22 cm. longis, 4 7 cm. latis, late obtuse acuminatis, basi acutis; nervis primariis utrinque 12–15, distantibus, distinctis, patulis, fere ad marginem obscure curvato-anastomosantibus; reticulis obsoletis vel subobsoletis; petiolo 1 1.3 cm. longo; inflorescentiis 7–9 cm. longis, in axillis superioribus, subcymoso-umbellatis, plerumque 5-floris; pedunculis 3 5 cm. longis; pedicellis usque ad 7 mm. longis, parce pubescentibus, sursum paulo incrassatis; calycibus plus minusve pubescentibus, lobis ovatis, vel late ovatis, subacutis vel subrotundatis, 2 mm. longis, margine ciliatis; corollae tubo 1 cm. longo, circiter 1.5 mm. diametro, extus deorsum glabro, sursum pubescenti; lobis elliptico-ovatis, rotundatis, extus in partibus expositis breviter pubescentibus.

SUMATRA, East Coast, Asahan, Laboehan Batoe, Kota Pinang, Si Mangi Angin, on the Soengei Kanan (topographic sheet 41, south-

east corner), *Rahmat 4133* (type), April 15 to May 16, 1933; *Rahmat 7602*, from Loemban Ria, Feb. 5 to April 12, 1935, with the local name *kajoe laning*, probably represents the same species.

This is an Ervatamia, according to those who recognize that as a genus distinct from Tabernaemontana. It resembles *Tabernaemontana sumatrana* Merr., but has peduncled, axillary, subumbellate inflorescences, whereas the pedicels, calyces, upper parts of the corolla tubes, and the exposed parts of the corolla lobes are distinctly pubescent.

Alyxia triptera Merrill, sp. nov.

Speciei A. Scortechinii King & Prain affinis, differt omnibus partibus glabris (floribus ignotis), cymis paucifloris, distincte pedunculatis. Frutex scandens, glaber, ramis ramulisque 3-angulatis, anguste 3-alatis, ultimis 4 mm. diametro, glaberrimis; foliis ternatim verticillatis, oblongis vel oblongo-ellipticis, coriaceis, 12–15 cm. longis, 4–6 cm. latis, breviter acuminatis, basi acutis, margine revolutis, in siccitate supra subviridibus, nitidis, subtus pallidioribus, nervis primariis utrinque saltem 50, patulis, subtus obscuris vel subobsoletis, supra haud perspicuis, quam secundariis haud magis distinctioribus; petiolo circiter 1 cm. longo; cymis fructiferis 4–5 cm. longis, glabris; pedunculo circiter 1 cm. longo, floribus ut videtur paucis, drupis normaliter 2 vel 3, oblongo-ellipsoideis, 2–2.3 cm. longis, breviter rostratis, basi acutis, longe (usque ad 1 cm.) stipitatis.

SUMATRA, East Coast, Asahan, Adian Rindang, near Hoeta Tomoean Dolok (Tomoean Dolok), *Rahmat 8619*, Nov. 17 to Dec. 10, 1935; local name *andor si palas sani*.

A species manifestly allied to *Alyxia Scortechinii* King & Gamble of the Malay Peninsula, to which its authors at least tentatively refer *Beccari 333* from Sumatra. The cymes are solitary, not densely crowded, rather long-peduncled, not sessile, few-flowered rather than apparently many-flowered, whereas the Sumatra plant is glabrous throughout, with no traces of indumentum on the branchlets and leaves. The species is characterized by three-angled and narrowly three-winged ultimate branches, leaves in whorls of three, and long stipitate fruits.

LABIATAE

NOSEMA COCHINCHINENSIS (Lour.) Merr., Trans. Am. Philos. Soc., II, 24 (2): 343. 1935.

Dracocephalum cochinchinense Lour., Fl. Cochinch., 371. 1790.
Geniosporum holocheilum Hance, Journ. Bot., 17: 13. 1879, *ex descr.*
Anisochilus sinensis Hance, Journ. Bot., 23: 327. 1885.
Mesona prunelloides Hemsl., Journ. Linn. Soc. Bot., 26: 267. 1890; Doan, in Lecomte, Fl. Gén. Indo-Chine, 4: 932. 1936.
Nosema prunelloides Prain, Journ. As. Soc. Bengal, 73 (2): 21. 1904.

SUMATRA, East Coast, Langga Pajang, and Si Mandi Angin, on the Soengei Kanan, *Rahmat 3315, 3542, 4116, 4151*, March-May, 1933. Southeastern China (Kwangtung), Hainan, and Indo-China.

No representative of Mesona or of the segregated genus Nosema is recorded from the Malay Peninsula. The genus is new to the records of Sumatra.

PARAPHLOMIS OBLONGIFOLIA (Blume) Prain, Ann. Bot. Gard. Calcutta, 9: 60. 1901.

Leonurus oblongifolius Blume, Bijdr., 828 1826.
Gomphostemma macrophyllum Miq., Fl. Ind. Bat., 2: 988. 1859.

SUMATRA, East Coast, Asahan, Bĕrastagi, *Hamel & Rahmat 569*, June 10, 1928. Java, Celebes.

MICROTOENA INSUAVIS (Hance) Prain, in Dunn, Notes Bot. Gard. Edinburgh, 6: 188. 1915; Merr., Lingnan Sci. Journ., 13: 46. 1934, *cum syn.*

SUMATRA, East Coast, Karoland, Kĕban Djahe, *Hamel & Rahmat 689*, June 18, 1928. Assam to Burma, western and southern China. The genus is new to the records of Sumatra.

SOLANACEAE

SOLANUM CYANOCARPHIUM Blume, Bijdr., 700. 1826; Backer & Van Slooten, Geillustr. Handb. Java. Theeonkr., 194, t. 194. 1924.

Solanum sarmentosum Nees, Trans. Linn. Soc., 17: 58. 1834; Ridl. Fl. Malay Penin., 2: 469. 1923.
Solanum sparsiflorum Elm., Leafl. Philip. Bot., 5: 1838. 1913.

SUMATRA, East Coast, Bila, near Rantau Parapat, *Rahmat 1639, 2926*, March-July, 1932; local names *tioeng, teroeng oetan*. Malay Peninsula, Java, Borneo, and Palawan; Bohol and Mindanao in the Philippines.

GESNERIACEAE

AESCHYNANTHUS OBCONICUS C. B. Clarke, in DC., Monog. Phan., 5: 50. 1883; Hook. f., Bot. Mag., 120, t. 7336. 1894; Ridl., Fl. Malay Penin., 2: 500. 1923.

SUMATRA, East Coast, Asahan, near Loemban Ria, *Rahmat 7846*, Feb. April, 1934; local name *andor rodang*. Malay Peninsula, Borneo.

ACANTHACEAE

STAUROGYNE SPATULATA (Blume) Koord., Exkursionsfl. Java, 3: 211. 1912.

Adenosma spatulata Blume, Bijdr., 757. 1826.
Staurogyne glauca O. Ktze., Rev. Gen. Pl., 497. 1891.
Ebermaiera glauca Nees var. *spatulata* C. B. Clarke, in Hook. f., Fl. Brit. Ind., 4: 396. 1884.

SUMATRA, Tapianoeli, along the Aek Roppak, near Hoeta Imbaroe, *Rahmat 4795*, June, 1933. Burma and Indo-China; Java. Not recorded from the Malay Peninsula.

RUBIACEAE

SAPROSMA PUBESCENS Ridl., Journ. As. Soc. Straits Branch, 61: 22. 1912; Fl. Malay Penin., 2: 171. 1923.

SUMATRA, East Coast, Koealoe, Damoeli, *Rahmat 1316*, Sept., 1928. Siam and the Malay Peninsula (Pahang); var. *hirsuta* Ridl. in Malacca.

COMPOSITAE

SPILANTHES OLERACEA Linn., Syst. Nat., ed. 12, 2: 534. 1767; A. H. Moore, Proc. Am. Acad., 42: 530. 1907 (Contrib. Gray Herb., 33: 530).

SUMATRA, East Coast, Bila, Goenoeng Soeasah, Rantau Parapat, *Rahmat 2349*, May, 1922; Tapianoeli, Padang Si Dimpoean, Padang Lawas, *Rahmat 4587*, June, 1933; local names *si kappir*, *si happir*. A native of tropical America; introduced into various parts of the Old World, such as Japan, India, Java, and Tahiti.

GALINSOGA PARVIFLORA Cav., Ic., 3: 41, t. 281. 1794; Backer & Van Slooten, Geillustr. Handb. Jav. Theeonkr., 230, t. 230. 1924; Backer, Onkruidfl. Jav. Suikerrietgr., 801. 1931.

SUMATRA, East Coast, Karoland, Běrastagi, *Hamel 441* and *Rahmat 567*, June, 1928. A weed of tropical American origin; a recent introduction into Sumatra. Common in Java, where it was introduced in the last decade of the nineteenth century.

ARTEMISIA LACTIFLORA Wall., List, no. 414 in DC., Prodr., 6: 115. 1837.

SUMATRA, East Coast, Asahan, Aer Djoman, *Rahmat 8359*, Oct. 9, 1935; local name *doehoet sop*. Widely distributed in China. Recorded by Kerr as cultivated in Siam; perhaps introduced into Sumatra.

BLUMEA BICOLOR Merr., Philip. Journ. Sci., 7 : Bot. 356. 1912.

SUMATRA, East Coast, Karoland, kilometer 57, Medan Road, *Hamel & Rahmat 493*, June 7, 1928. Philippines and New Guinea.

BLAINVILLEA LATIFOLIA (Linn. f.) DC., in Wight, Contrib., 17. 1834; Prodr., 5 : 492. 1836; Hook. f., Fl. Brit. Ind., 3 : 305. 1881.

Eclipta latifolia Linn. f., Suppl. 378. 1781.

SUMATRA, East Coast, Karoland, Medan Road at kilometer 57, *Hamel & Rahmat 489*, June 7, 1928. A pantropic weed of American origin now widely distributed in both hemispheres.

Ainsliaea longipetiolata Merrill, sp. nov. § *Scaposae*.

Herba circiter 50 cm. alta, caulibus gracilibus, subadpresse ciliato-villosis; foliis paucis, longe (5–8 cm.) petiolatis, lamina elliptico-ovata, submembranacea, 5–7 cm. longa, 2.5–3.5 cm. lata, acuta vel breviter acuminata, basi angustata, leviter decurrenti-acuminata, margine distanter crenata atque patule anguste apiculato-serrata, dentibus circiter 1 mm. longis, utrinque conspersissime ciliato-villosis, nervis utrinque 2 vel 3, distantibus, gracilibus, laxe arcuato-anastomosantibus, reticulis obsoletis vel subobsoletis; petiolo consperse ciliato-villoso; inflorescentiis longe exsertis, spiciformibus, simplicibus, deorsum folia pauca valde reducta lanceolata bracteiformia acuminata circiter 1 cm. longa gerentibus; capitulis solitariis, binis, vel depauperato-fasciculatis, sessilibus vel brevissime pedicellatis, paucifloris, lanceolatis, circiter 1 cm. longis, 1–2 cm. remotis; involucri bracteis lanceolatis, acuminatis, exterioribus brevibus, interioribus capitula subaequantibus, leviter ciliatis.

SUMATRA, East Coast, Karo Highlands, summit of Dĕlĕng Pintoe, *Carel Hamel & Rahmat 615*, June 11, 1928.

A species in the group with *Ainsliaea pteropoda* DC., but with long and practically wingless petioles, in some respects resembling *A. reflexa* Merr., though with much larger leaves than the latter species.

ARNOLD ARBORETUM
HARVARD UNIVERSITY

CERTAIN SPECIES OF INOCYBE IN THE HERBARIUM OF THE UNIVERSITY OF MICHIGAN *

ALEXANDER H. SMITH

THE need for illustrations of the microscopic characters of species in the Agaricaceae is admittedly great, particularly in the genus Inocybe. Thanks to the studies of Heim (1), Kühner (3), Lange (5), and others, the European species have been critically investigated and their microscopic characters well illustrated. American species, however, have not been studied and illustrated in such detail. Kauffman (2) recognized the value of these characters and employed them in the only critical study of the genus made to date in North America, but he did not publish illustrations. As a result, in trying to compare the European and the American Inocybe floras one frequently finds it difficult to reach definite decisions.

I have gathered together all the type material in Kauffman's collections, and here publish drawings of spores and cystidia of the various species. Certain of Peck's, Atkinson's, and Murrill's species are included because of authentic material which they gave to Kauffman and which is now in his collections. Information on a number of my own collections, which are also deposited in the University of Michigan Herbarium, seems pertinent at this time, and hence is included.

The collection numbers cited are the writer's. The color names in quotation marks are taken from Ridgway, *Color Standards and Color Nomenclature*, 1912. The investigation has been partly supported by funds received from the Horace H. Rackham School of Graduate Studies of the University of Michigan.

LIST OF SPECIES

Inocybe ferruginosa, sp. nov. (Pl. II, Fig. 3; Pl. III, Figs. 15-16). — Pileus 1-3 cm. latus, conicus, fibrillosus vel subglaber, rufus vel ferrugineus; lamellae confertae, latae, ochraceae demum brun-

* Papers from the Herbarium of the University of Michigan.

neae, adnatae; stipes 3–8 cm. longus, 4–8 mm. crassus, rufo-fibrillosus, farctus; sporae 7–9 × 5–6 μ, leves; cheilocystidia clavata. Specimen typicum legit A. H. Smith n. 2779 prope Joyce, Washington, Oct. 2, 1935; in Herb. Univ. Mich. conservatum.

Pileus 1–3 cm. broad, conic, campanulate or with a prominent acute umbo, innately fibrillose or with the disc appearing glabrous and the margin with matted appressed fibrils, subviscid when moist, not becoming scaly or rimose, color evenly "vinaceous-rufous" to "ferruginous," flesh thick on the disc, thinner near the margin, whitish to "pale ochraceous-buff," taste slight but nauseating, odor faintly spermatic; lamellae close, moderately broad, equal, edge even, "raw sienna" at first and slowly changing to "amber brown," seceding readily; stipe 3–8 cm. × 4–8 mm., fleshy, equal above the slightly thickened base, stuffed at first, hollow in age, lower portion covered by "vinaceous-rufous" fibrils left by the coarsely fibrillose veil, apex more or less fibrillose scurfy and pallid yellowish incarnate, flesh reddish at the base and yellowish incarnate at the apex; spores 7–9 × 5–6 μ, smooth or with a very slightly wrinkled outer wall, ellipsoid, hyaline apiculus obscure; basidia four-spored; pleurocystidia not differentiated, cheilocystidia clavate, smooth, thin-walled, only slightly larger than immature basidia; pileus trama homogeneous.

Gregarious on wet soil under brush, Joyce, Washington, Oct. 2, 1935 (2779 — type). This species resembles *I. geophylla* in stature and veil characters, but the constant reddish ferruginous color and the lack of pleurocystidia readily distinguish it. The smallest buttons (2–4 mm.) were as brightly colored as the mature pilei. In color and markings the spores bear some resemblance to those of certain Cortinarii. They are dark rusty brown and have a faintly wrinkled exospore (when viewed under an oil-immersion objective). These characters are not sufficient, however, to offset the very decided Inocybe-like appearance, partial veil, consistency, odor, and taste. The specimens dry a dull reddish brown, and the hyphae of the stipe, pileus, and gill trama are frequently filled with a bright cinnabar-red amorphous content, as are also many of the cells in the hymenium. No typical lactiferous hyphae were seen. The species seems closely allied to the incompletely described *I. cinnabarina* Hruby, but

differs in the whitish to pale buff flesh of the pileus, the bright yellowish brown gills, and the smooth cheilocystidia.

Inocybe multicoronata, sp. nov. (Pl. I, Fig. 1; Pl. III, Fig. 1). — Pileus 1–2.5 cm. latus, conicus demum umbonatus, fibrillosus, demum rimosus et fibrillose squamosus, brunneus; lamellae confertae, angustae vel latiusculae, pallide brunneae; stipes 6–8 cm. longus, 1.5–2 mm. crassus, pallide brunneus, sursum subincarnatus, deorsum fibrillosus; sporae 8–11 μ, globosae, multicoronatae; pleurocystidia et cheilocystidia 50–90 × 10–18 μ. Specimen typicum legit A. H. Smith prope Truro, in Nova Scotia, Canada, July 22, 1931; in Herb. Univ. Mich. conservatum.

Pileus 1–2.5 cm. broad, sharply conic-campanulate, becoming more or less expanded with an acute umbo, dry, innately fibrillose with "cinnamon-brown" fibrils at very first, soon rimose to the umbo, the fibrils often recurving to form conspicuous fibrillose scales, scales scattered near the margin and crowded near the disc, in age the fibrils often wearing away and the color becoming a sordid buff; flesh thin, pliant, odor and taste not distinctive; lamellae close, narrow to moderately broad near the margin, edge slightly fimbriate, pallid brownish, becoming "cinnamon-brown"; stipe 6–8 cm. × 1.5–2 mm., equal, rather tough, tubular, pallid brownish or with a reddish tinge above, fibrillose below, faintly pruinose at first; spores 8–11 μ, globose in outline, covered with six to nine primary tubercles, each tubercle crowned with one to three smaller obtuse projections, dark tawny brown under the microscope; basidia four-spored; pleurocystidia scattered, thick-walled and with incrusted apices or thin-walled and smooth, 50–90 × 10–18 μ, cheilocystidia similar to the thin-walled pleurocystidia or more saccate.

Scattered on soil in a ravine, near Truro, Nova Scotia, July 22, 1931. The spores of this species are unique even for an Inocybe. In stature, color, and consistency the species resembles *I. calospora* Quél.; perhaps it is largely because of this resemblance that it has been overlooked previously.

Inocybe olympiana, sp. nov. (Pl. II, Fig. 2; Pl. IV, Fig. 1; Pl. V). — Pileus (2)3–7 cm. latus, obtuse conicus, demum convexus vel subplanus, fibrillosus, margine subrimosus, ochraceobrunneus; lamellae confertae, angustae vel ventricosae, adnatae, pallidae demum ochraceobrunneae; stipes 6–12 cm. longus, 8–12 mm.

crassus, solidus, subbulbosus, pallidus, demum sordide brunneus; sporae 7–9 × 4–5 μ; pleurocystidia et cheilocystidia 60–90 × 10–16 μ. Specimen typicum legit A. H. Smith n. 3230 prope Lake Crescent, Washington, Oct. 17, 1935; in Herb. Univ. Mich. conservatum.

Pileus (2)3–7 cm. broad, obtusely conic, becoming convex and finally nearly plane, dry, innately fibrillose, becoming rimose on the margin and fibrillose-scaly on the disc, in age the disc often becoming areolate-cracked, color varying from "Sayal brown" to "buckthorn brown," darker in age; flesh white, thick, odor and taste not distinctive or subfarinaceous; lamellae close, narrow or ventricose and broad, bluntly adnate or with a slight decurrent tooth, whitish to pallid, becoming "tawny-olive," edge white-fimbriate; stipe 6–12 cm. × 8–12 mm., equal above a subemarginate to emarginate bulb, solid, whitish above and sordid brown near the base at first, in age tawny over all, sparsely fibrillose below and coarsely pruinose above; spores 7–9 × 4–5 μ, smooth, inequilateral and somewhat ventricose; pleurocystidia very abundant, thick-walled, apex incrusted, 60–90 × 10–16 μ, cheilocystidia similar but shorter; basidia four-spored.

Gregarious under fir, Lake Crescent, Washington, Oct. 17, 1935 (3230 — type), and Lake Quiniault, Washington, Oct. 3 to Nov. 5, 1935, C. H. Kauffman. The colors and stature of my specimens are very similar to those represented by Heim's illustration of *I. dulcamara* (1, pl. 5, fig. 4). The long conspicuous cystidia and spores are similar to those of *I. mutica* illustrated by Heim, but apparently have thicker bright yellow walls. It differs from *I. mutica* sensu Heim in its solid more bulbous stipe and darker brown colors. It is most closely related to *I. subochracea* Peck, but differs in color, more or less emarginate bulbous stipe, much larger stature, and the distinctly fibrillose-scaly pileus. Kauffman had tentatively considered the plant to be new, and such a disposition of our collections seems preferable to forcing it into any other species. A different disposition of it may be desirable when more is known of the variations of *I. subochracea* in different regions.

INOCYBE HIRSUTA var. **maxima**, var. nov. (Pl. II, Fig. 4). — Pileus 2–5 cm. latus, convexus demum subplanus, squamosus, badiobrunneus; lamellae latae, confertae, adnexae, brunneae; stipes

7–9 cm. longus, 7–10 mm. crassus, sparse fibrillosus vel fibrillose squamulosus, apice pallidus; sporae 9–11 × 5–6 μ; cheilocystidia clavata, 30–50 × 8–15 μ. Specimen typicum legit A. H. Smith n. 3400 prope Joyce, Washington, Oct. 28, 1935; in Herb. Univ. Mich. conservatum.

Pileus 2–5 cm. broad, broadly convex to plane or with the margin abruptly decurved, surface dry, covered by recurved persistent fibrillose scales arranged in approximately concentric rows toward the margin, scales on the disc squarrose and crowded, evenly "Rood's brown" when fresh, fading somewhat in age or when dried, scales becoming "cinnamon-brown" or paler on a somewhat avellaneous background; flesh rather thick and firm, pallid brownish; lamellae close, broad, deeply adnexed, dark brown, concolorous with the pileus, edges white-fimbriate to crenulate; stipe 7–9 cm. × 7–10 mm., equal or enlarged toward the base, sparsely covered by loose fibrils or sparingly fibrillose-scaly to near the apex, concolorous with the pileus or the apex pallid brownish, reddish brown at the base; spores 9–11 × 5–6 μ, more or less bean-shaped, smooth; pleurocystidia not differentiated, cheilocystidia clavate, tapering to a long slender pedicel, abundant, 30–50 × 8–15 μ.

Gregarious under fir, Joyce, Washington, Oct. 28, 1935 (3400 — type). In the dried specimens the reddish cast in the flesh at the base of the stipe has faded, and the color is merely pallid or buff. The type specimens resemble dried material of *I. calamistrata* very closely, but the lack of greenish or bluish green stains at the base of the stem readily separates it in the fresh condition from that species.

INOCYBE EUTHELES (Berk. & Br.) Sacc. – Pileus (2) 4–8.5 cm. broad, obtusely conic, becoming convex or plane and usually more or less umbonate, dry, innately fibrillose, becoming subrimose on the margin and somewhat scaly near the disc from the breaking up of the fibrillose layer, "Natal brown" on the disc to "avellaneous" near the margin, in age "avellaneous" over all, margin usually decurved and fibrillose; flesh thick, whitish, firm, odor spermatic, taste subnauseous; lamellae close to subdistant, narrow to moderately broad, adnate or with a decurrent tooth, edge white-fimbriate, pale avellaneous, soon "fawn color" or "wood brown"; stipe 5–10 (12) cm. × 4–8 (10) mm., equal or both the

base and the apex slightly enlarged, solid, appressed silky fibrillose, pruinose above, apex "light vinaceous-fawn," whitish below but with scattered "fawn color" fibrils; spores 8–10 (11) × 5–5.5 μ, smooth, inequilateral, furnished with a hyaline apiculus; basidia four-spored; pleurocystidia 54–80 (100) × 10–15 μ, typically thick-walled, often incrusted, narrowly fusoid to nearly cylindric, scattered, cheilocystidia similar but shorter.

Gregarious under pine and fir, Trinidad, California, Nov. 27 (3632, 3633, 3641, 3658) and Dec. 6, 1935 (3854, 3855). The specimens cited here agree well with the description of the luxuriant form as given by Heim and clearly establish the presence of this typical form in North America. European investigators have referred *I. eutheloides* Pk. to the foregoing species as a synonym. In both the western and the central states I have observed all intergradations in size from the type Kauffman (2) described as *I. eutheloides* to that described above.

INOCYBE FASTIGIATA var. MICROSPERMA Bres. — Pileus 3.5–8 cm. broad, obtusely conic, becoming gibbous or nearly plane, at times the umbo subacute, at first near "avellaneous" over all, soon tinged reddish, finally "yellow ocher" to "ochraceous-tawny," with or without a reddish brown cast, long-rimose, often appearing streaked because of innate fibrils radially disposed; flesh thick on the disc, whitish, odor spermatic, taste slightly disagreeable; lamellae close, narrow, adnexed to depressed-adnate, whitish, becoming "avellaneous" to "wood brown," frequently tinged or spotted "tawny-olive," edge fimbriate; stipe 6–8 cm. × 8–12 mm., equal or with a slight submarginate bulb, solid, white within, silky white above, soon sordid ochraceous-tawny over all or in patches; spores 7–9.5 (10) × 4.5–6 μ, bean-shaped, smooth, without a hyaline apiculus; pleurocystidia not differentiated, cheilocystidia thin-walled, clavate-subcapitate above a long slender, often contorted pedicel, abundant.

Gregarious under oak, Saginaw Forest, Ann Arbor, Sept. 18, 1936 (4913, 4940). Heim (1), as a result of his studies of the type of *I. curreyi* Berk., gives its spores as 11–14 × 6–7 μ and properly refers the species to *I. fastigiata* as a variety. The fungus Kauffman (2) placed in *I. curreyi* is characterized by smaller spores and is here referred to *I. fastigiata* var. *microsperma* Bres. The narrow bulb is not a constant character, and the width of the

lamellae varies considerably. The tawny reddish tinge exhibited by some of my specimens was more conspicuous on old pilei which had remained under the covering of fallen leaves. Typical *I. fastigiata*, with its larger spores, and the small-spored variety mentioned above are both common and constant units in our agaric flora and deserve separate designation.

INOCYBE FUSCODISCA (Pk.) Massee (Pl. II, Fig. 1; Pl. IV, Fig. 10). — This species is placed in Hebeloma in the North American Flora. However, in view of its very close relationship to *I. virgata* Atk. and its obviously Inocybe-like stature and microscopic characters, no doubt remains as to its proper generic reference. In fact, a careful study of fresh material of *I. virgata* should be made to determine whether or not these two species are identical. Material sent to Kauffman by Peck has been examined along with material from Trinidad, California (3650 and 3848).

INOCYBE LANGEI Heim. — Pileus 2–6 cm. broad, obtusely conic to convex, plane or with an obtuse umbo at maturity, surface dry, innately fibrillose at first, rimose in age and the disc subareolate, becoming lacerate to squarrose-scaly in age at times, dull whitish to "pinkish buff" at first or tinged cinereous, becoming "cinnamon-buff" to "clay color" in age, occasionally darker and more tawny; flesh thick, white, firm, odor spermatic, taste none or somewhat disagreeable; lamellae broad, rounded and narrowly adnate, close, whitish, gray, soon darker and near "buckthorn brown" in age, edge fimbriate; stipe 6–7 cm. × 3–8 mm., white and pruinose at first, equal above a subbulbous base, solid, striate in age and turning sordid brownish especially below; spores 7–9 × 5–6 μ, subreniform, with an oblique hyaline apiculus, smooth; pleurocystidia 40–50 × 10–20 μ, rare or scattered, broadly ovate, with thickened walls, apex incrusted.

Gregarious or in troops under spruce, Saginaw Forest, Ann Arbor, Oct. 8, 1936 (5098). The smaller spores and the short obese cystidia separate this species from *I. euthele*s. The rose tints of the gills and the emarginate bulb of the stipe as described by Heim were not characteristic of my collections. These differences, in addition to the more robust stature, are not, in my opinion, important enough to be of taxonomic significance.

INOCYBE SUBCARPTA Kühner & Boursier (Pl. I, Fig. 4; Pl. III, Fig. 3; Pl. VI). — Pileus 3–7 cm. broad, broadly conic, later plane with

a conic umbo or the margin broadly deflexed in age, surface scaly or subsquarrose-scaly, the margin frequently incised but not rimose, evenly "snuff brown" to "bister"; flesh thick on the disc, tapering slightly to the margin, whitish or near "old gold," odor and taste not distinctive, fragile; lamellae close, narrow (3–3.5 mm.), equal, narrowly adnate, whitish at first, in age near "Rood's brown," even or slightly eroded, whitish and fimbriate; stipe 7–10 cm. × 8–12 mm., equal, stuffed, becoming hollow, base occasionally abruptly constricted, whitish at first and innately longitudinally fibrous-striate, becoming concolorous with the pileus in age; spores 8–10 (11) × 5–6 μ, ellipsoid in outline, covered by 8–12 obtuse nodules; basidia four-spored; cystidia on sides and edges of gills, thin-walled, 60–80 × 10–18 μ, clavate to cylindric, not incrusted.

Singly under pine, Florence, Oregon, Nov. 20, 1935 (3575), and on humus in a mixed forest, Lake Timagami, Ontario, Sept. 7, 1936 (4645). The description was drawn from the Oregon collection. The specimens from Timagami were somewhat past maturity. The obtuse more or less elongated cystidia separate this species from *I. decipientoides* Pk. The development of the recurved lacerate scales depends to some extent on the age of the pilei. Kühner and Boursier (4) described three forms under *I. subcarpta*. These are separated largely by spore size and by the number and degree of development of the tubercles on the spores. The spores of my collections are similar to those which they illustrated for form one.

INOCYBE RENNYI Berk. & Br. (Pl. I, Fig. 3; Pl. III, Fig. 4). – This species was collected in the vicinity of Boston, Massachusetts, July 10, 1916, July 19, 1918, and Sept. 16, 1918, by Simon Davis. Apparently it grew in sandy soil along with *I. decipientoides*, with which it was confused by Davis. No notes accompanied the specimens. Heim (1), in his study of the type of the species, has given an excellent account of the microscopic characters. The spores in all of Davis's collections ranged from 10 to 20 μ in length. The great majority, however, measured 12–16 × 5.5–7.5 μ. The length and the irregular outline are apparently constant characters

INOCYBE XANTHOMELAS Bousier & Kühner (Pl. I, Fig. 2; Pl. III, Fig. 2). – This species, described from French material in 1933,

was found at Trinidad, California, Dec. 6, 1935 (3853), and at Lake Timagami, Ontario, Aug. 20, 1936 (4049). The pilei in my collections measured 3.5–5 cm. broad; the stipes, 4–8 cm. × 3–6 mm. The pilei were "yellow ocher," with a somewhat tawny disc or at times entirely "clay color." The yellowish rimose pileus, the emarginate bulb, and the stipe, which blackens in drying, are outstanding macroscopic characters. The spores of No. 3853 measure 8–10 × 6–7 μ; the cystidia, 70–90 × 8–12 μ. Spores of No. 4049 measure 8–11 (12) × 7–8 μ; the cystidia, 60–75 × 10–16 μ.

INOCYBE ABUNDANS Murrill (Pl. I, Fig. 6; Pl. III, Fig. 8). — My study of the type confirms the information given by Kauffman (2). The spores measure 5.5–8 × 4.5–6 μ and have from eight to fourteen rather indistinct blunt nodules. The basidia are four-spored. No lactifers were seen. Although the stipe was described as equal by Kauffman, the dried specimens strongly indicate the presence of a marginate bulb. This point, however, is very difficult to determine in dried specimens because in drying the soil holds the basal portion of the stipe to its natural size, whereas the part immediately above ground frequently collapses and thus gives the impression of a bulb. Murrill's species is certainly closely allied to *I. mixtilis* sensu Kühner (3), and a study of fresh specimens should be made with this relationship in mind.

INOCYBE ALABAMENSIS Kauff. (Pl. I, Fig. 5; Pl. III, Fig. 7). — The spores vary in size. According to my measurements, they are 7–10 × 4–5 μ and have from six to ten nodules or angles. The spores and the cystidia somewhat resemble those of *I. Boltoni* Heim, but the silvery gray innately silky pileus separates it as a rather distinct type. The pilei are neither scaly nor rimose in the dried condition.

INOCYBE ASTORIANA Murrill (Pl. I, Fig. 8; Pl. III, Fig. 5). — The drawings are from Murrill's type. Kauffman considered it a synonym of *I. decipientoides* Pk. I have never collected it.

INOCYBE BRUNNESCENS Atk. (Pl. II, Fig. 22; Pl. III, Fig. 18). — Kauffman placed this species in synonymy with *I. fastigiella* Atk. The spores of the type measure 8–10.5 × 5–6 μ and are bean-shaped. Typical lactifers are present in the flesh of the stipe and the cap. The fruit bodies appear to me to be identical with the specimens I have referred to *I. fastigiata* var. *microsperma*.

INOCYBE CASTANEA Peck (Pl. I, Fig. 9; Pl. III, Fig. 9). — The microscopic characters relate it to the species Heim designates as *I. umboninota* Pk. sensu Lange.

INOCYBE CICATRICATA Ell. & Ev. (Pl. I, Fig. 10; Pl. III, Fig. 11). — Heim (1) has published illustrations of the microscopic characters of this species. No lactifers were seen in my mounts. The nodules on the spores vary from inconspicuous to rather prominent, and the number ranges from seven to eleven on a spore.

INOCYBE CONNEXA Kauff. (Pl. II, Fig. 21; Pl. IV, Fig. 8). — The cystidia may be either thick- or thin-walled. Both types were found on a single pileus. They measure 40–60 × 10–16 μ. The spores measure 7–10 × 4–5 μ, and lactifers are present in the flesh of the stipe and the pileus. As is indicated by Kauffman's arrangement, this species is closely related to *I. subochracea*.

INOCYBE DAVISIANA Kauff. (Pl. I, Fig. 13; Pl. III, Fig. 13). — The spores have from eight to eleven angles or nodules scattered over the surface. My measurements are the same as Kauffman's. In Heim's classification it should be arranged near *I. trechispora*, from which the spores readily separate it.

INOCYBE EARLEANA Kauff. (Pl. I, Fig. 12; Pl. III, Fig. 14). — The spores measure 7–9 × 5–6 μ and have from twelve to twenty obtuse nodules. No lactifers were seen. It is closely related to *I. castanea*.

INOCYBE GEOPHYLLA f. PERPLEXA Kauff. (Pl. II, Fig. 12; Pl. III, Fig. 12). — The spores of the type measure 7–8.5 × 4–5 μ. The cystidia are abundant on the sides, scattered on the edge, and measure 40–65 × 12–16 μ. Lactifers were found in the stipe tissue, but were not abundant. There seems to be no difference between this form and var. *lateritia* Weinm. as the variety is interpreted in Europe. It is very common in the Olympic Peninsula of Washington and is rather robust. The pileus measures 2.5–5 cm.; the stipe, 6–8 cm. × 4–8 mm.

INOCYBE GLABER Kauff. (Pl. II, Fig. 18). — The spores and the cheilocystidia are as Kauffman described them. Lactifers were scattered through the stipe. Apparently *I. perbrevis* sensu Cke. in Heim (1) is closely related to it.

INOCYBE LANATODISCA Kauff. (Pl. II, Fig. 23; Pl. III, Fig. 17). — Lactifers are present in the flesh of the stipe and the pileus. Heim (1) suggests that this is probably *I. maculata* Boud. His

figures show, however, a decidedly colored fungus, whereas Kauffman's specimens give the impression of a white species with a faintly brownish ground color. The lactifers and the spores, however, indicate a close relationship with *I. maculata*.

INOCYBE LONGIPES Kauff. (Pl. II, Fig. 20; Pl. IV, Fig. 11). — A few refractive hyphae resembling lactifers were found. The spore size seems to be quite variable. In the type they measure 8–10 × 5–6 μ or 9–12 × 5–6 μ. In one collection from near Ann Arbor they measure 7–9 × 4.5–6 μ. This species is very closely related to *I. geophylla*. In dry weather it is dull white or cream-colored, and such material does not change color as the specimens are prepared for the herbarium. If the fruit bodies develop under humid conditions the pilei become sordid isabelline by maturity, and when dried are a sordid ochraceous-brown or ochraceous-buff. Since the name *I. longipes* Massee, 1908, antedates Kauffman's name, the new name **Inocybe Kauffmani** is here proposed for the species Kauffman described.

INOCYBE LORILLARDINA Murrill (Pl. II, Fig. 19). — No lactifers were seen. The spores measured 9–11 × 5–6 μ. Apparently it is very closely related to *I. dulcamara* sensu Heim.

INOCYBE NODULOSA Kauff. (Pl. I, Fig. 7; Pl. III, Fig. 6). — No refractive hyphae were seen. The spores have from six to eleven obtuse prominent nodules. They somewhat resemble those of *I. asterospora*, but the nodules are coarser. The combination of the spores, thin-walled cystidia, and marginate bulb place it in a stirpe by itself.

INOCYBE OCHRACEOMARGINATA Kauff. (Pl. II, Fig. 17; Pl. IV, Fig. 7). — Lactifers are scattered through the tissue of the stipe and the pileus. Apparently the species is closely allied to *I. lucifuga*.

INOCYBE OVALISPORA Kauff. (Pl. II, Fig. 16; Pl. IV, Fig. 6). — Lactifers are present in the flesh of the stipe and the pileus. The cystidia and the spores are as Kauffman described them. The species is related to *I. eutheles*.

INOCYBE PALLIDOBRUNNEA Kauff. (Pl. II, Fig. 15; Pl. IV, Fig. 5). — Lactifers are rare in the flesh of the stipe. The cystidia are usually more or less cylindric, but occasional obese individuals with thickened walls are found. Apparently it should be arranged in the section Scabellae of Heim.

INOCYBE RIMOSOIDES Peck (Pl. II, Fig. 14). — Lactifers are present

in the flesh of the stipe and the pileus. The relationship of this species to *I. fastigiata* var. *microsperma* should be carefully studied.

INOCYBE RUFIDULA Kauff. (Pl. II, Fig. 13; Pl. IV, Fig. 4). — For a discussion of *I. scabella* and *I. Friesii* see Heim (1). It seems to be closely allied to *I. Friesii* forma *nemorosa* Heim, but the colors are brighter than those shown in his illustrations. No lactifers were found in the stipe or the pileus.

INOCYBE SISKIYOUENSIS Kauff. (Pl. II, Fig. 11; Pl. IV, Fig. 2). — Lactifers are present but rare. The cystidia are 40–60 by 8–16 μ.

INOCYBE SORORIA Kauff. (Pl. II, Fig. 10). — Lactifers are present in the stipe and the pileus. The species is very close to *I. fastigiata.*

INOCYBE SQUAMOSODISCA Peck (Pl. II, Fig. 9). — This species is very close to *I. caesariata.* A comparative study of the two based on fresh material is highly desirable.

INOCYBE SUBDECURRENS E. & E. (Pl. II, Fig. 7). — Lactifers are present, but not numerous. In my mounts the spores did not exceed 10 μ in length.

INOCYBE SUBDESTRICTA Kauff. (Pl. II, Fig. 8; Pl IV, Fig. 9). — No lactifers were seen. The spores and the cystidia are as Kauffman described them. The species is closely related to *I. eutheles.*

INOCYBE SUBFULVA Peck (Pl. I, Fig. 11; Pl. III, Fig. 10). — This species has properly been referred to *I. calospora* Quél. as a variety by Heim (1). Cystidia are present but rare on the sides and edges of the gills. The spores as well as the pilei of the variety are a brighter yellowish brown than those of the species.

INOCYBE TOMENTOSA E. & E. (Pl. II, Fig. 6). - This is the same as *I. subdecurrens;* see Kauffman (2).

INOCYBE VIRGATA Atk. (Pl. II, Fig. 5; Pl. IV, Fig. 3). Lactifers are rare in the stipe and the pileus. Apparently it is closely allied to *I. agglutinata* Pk.

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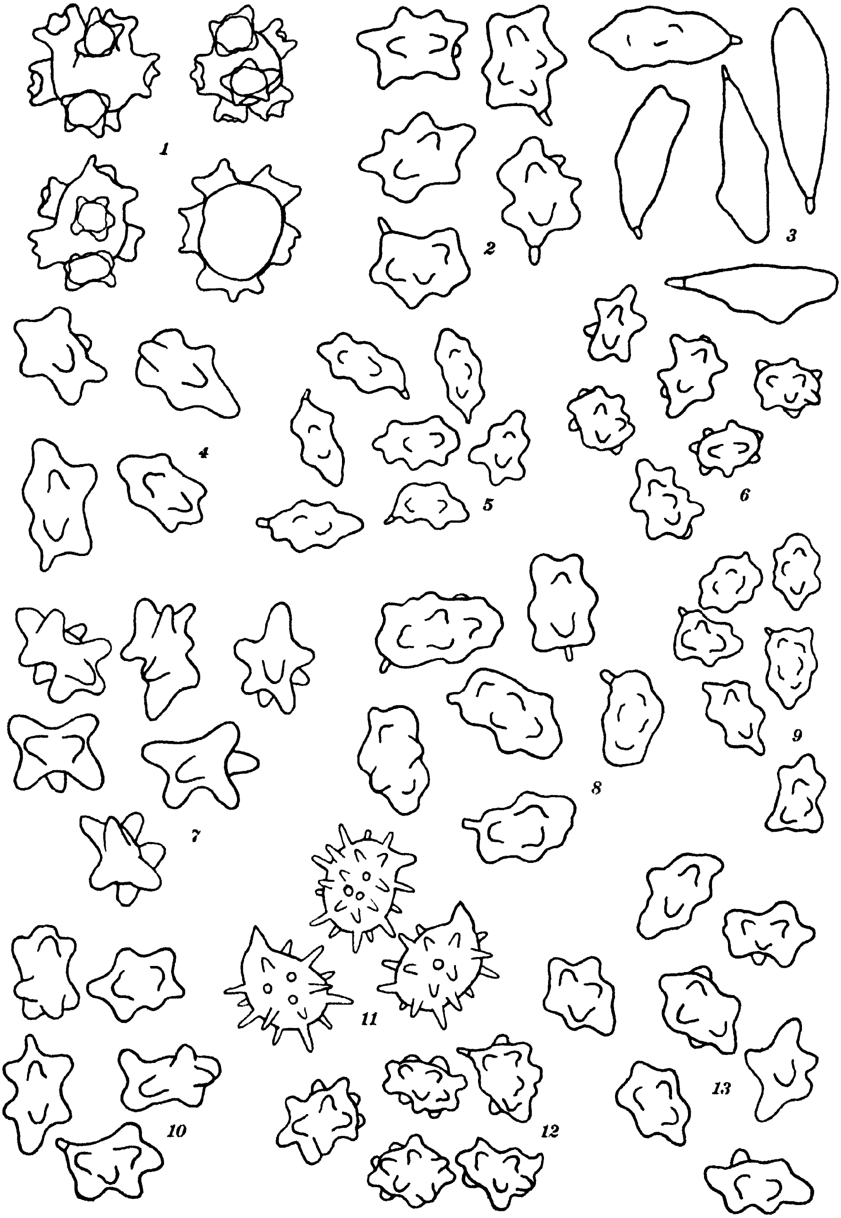
NOTE

The spores were drawn with the aid of a camera lucida and a Zeiss oil-immersion objective of N. A. 1.25. As the figures are reproduced, the magnification is approximately 1650. The cystidia were drawn at a magnification of 1500, but were reduced to one fourth of this size in the reproduction.

EXPLANATION OF PLATE I

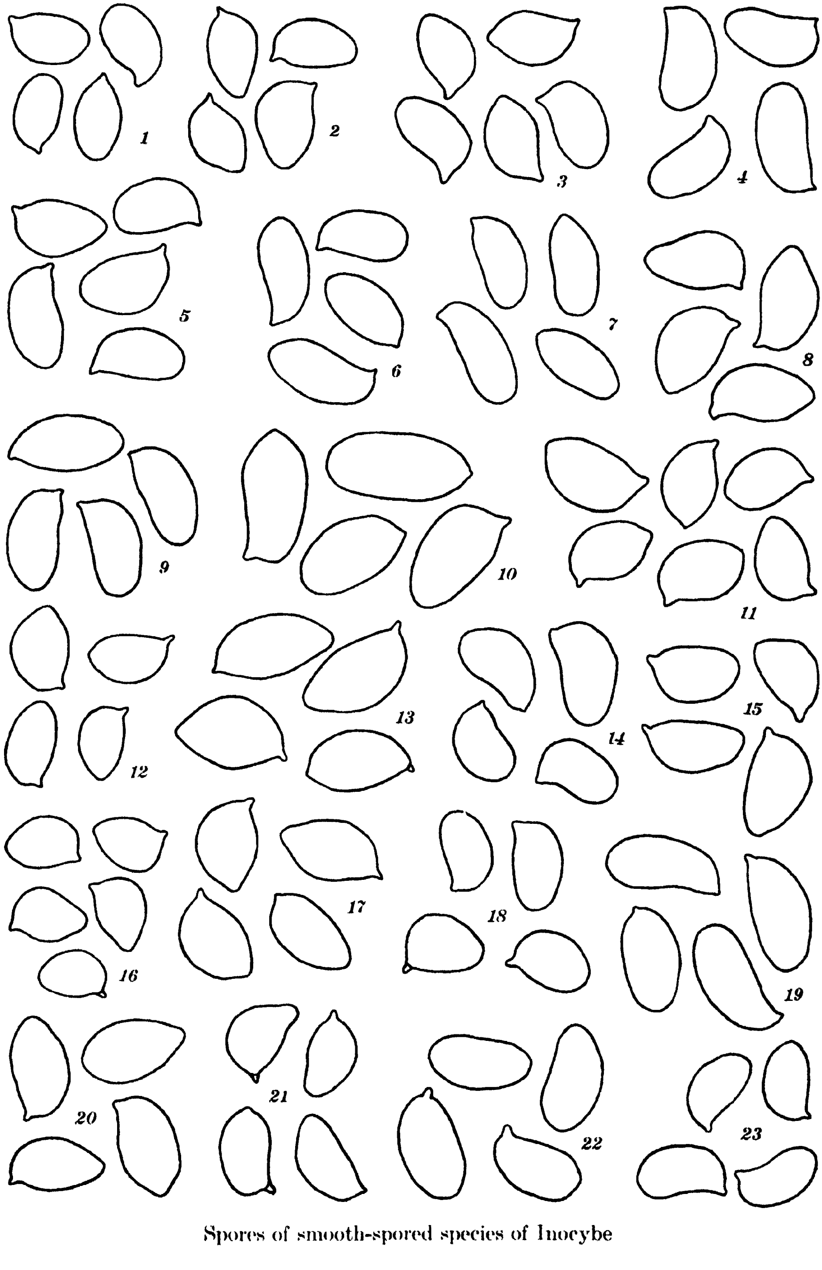
1. Inocybe multicoronata, four spores
2. I. xanthomelas, five spores
3. I. Rennyi, five spores
4. I. subcarpta, four spores
5. I. alabamensis, seven spores
6. I. abundans, six spores
7. I. nodulosa, six spores
8. I. astoriana, six spores
9. I. castanea, five spores
10. I. cicatricata, five spores
11. I. subfulva, three spores
12. I. Earleana, five spores
13. I. Davisiana, seven spores



Spores of rough-spored species of Inocybe

EXPLANATION OF PLATE II

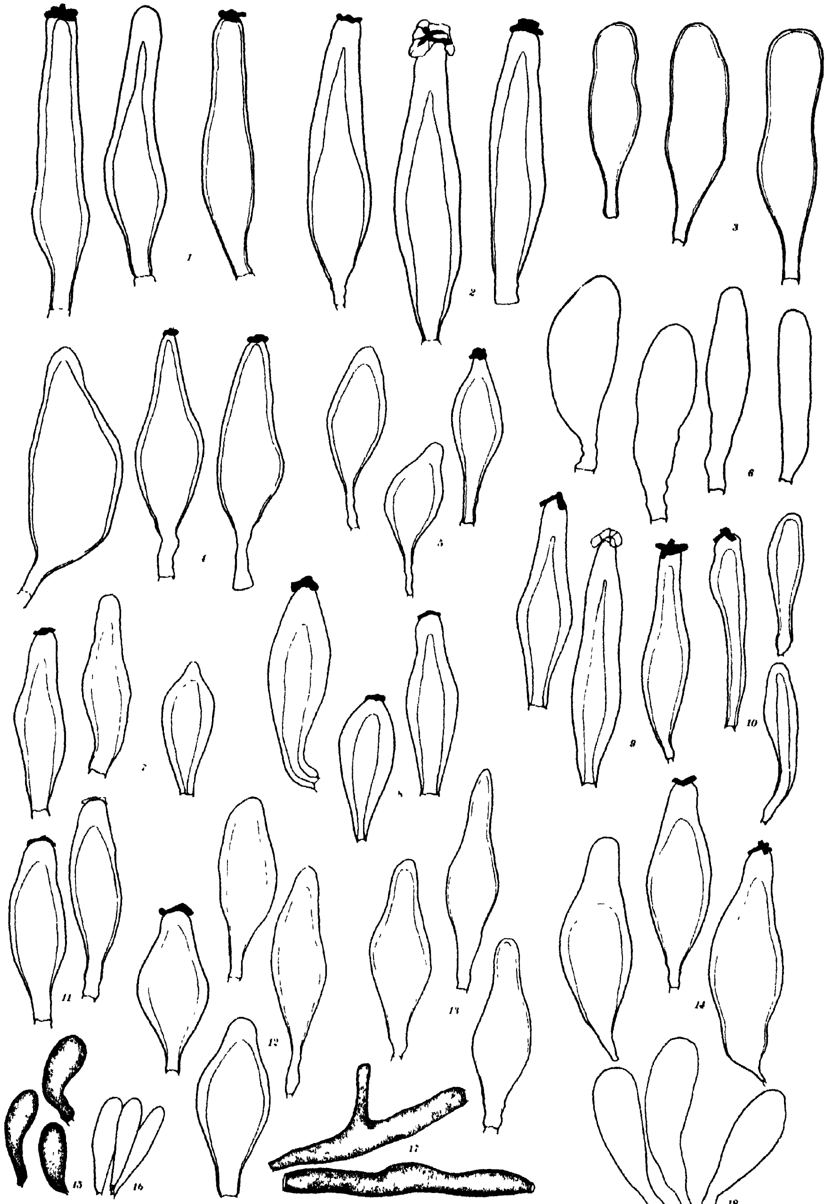
1. Inocybe fuscodisca Peck, four spores
2. I. olympiana, four spores
3. I. ferruginosa, five spores
4. I. hirsuta var. maxima, four spores
5. I. virgata, five spores
6. I. tomentosa, six spores
7. I. subdecurrens, four spores
8. I. subdestricta, four spores
9. I. squamosodisca, four spores
10. I. sororia, four spores
11. I. siskiyouensis, six spores
12. I. geophylla f. perplexa, four spores
13. I. rufidula, four spores
14. I. rimosoides, four spores
15. I. pallidobrunnea, four spores
16. I. ovalispora, five spores
17. I. ochraceomarginata, four spores
18. I. glaber, four spores
19. I. Lorillardiana, four spores
20. I. Kauffmani, four spores
21. I. connexa, four spores
22. I. brunnescens, four spores
23. I. lanatodisca, four spores



Spores of smooth-spored species of Inocybe

EXPLANATION OF PLATE III

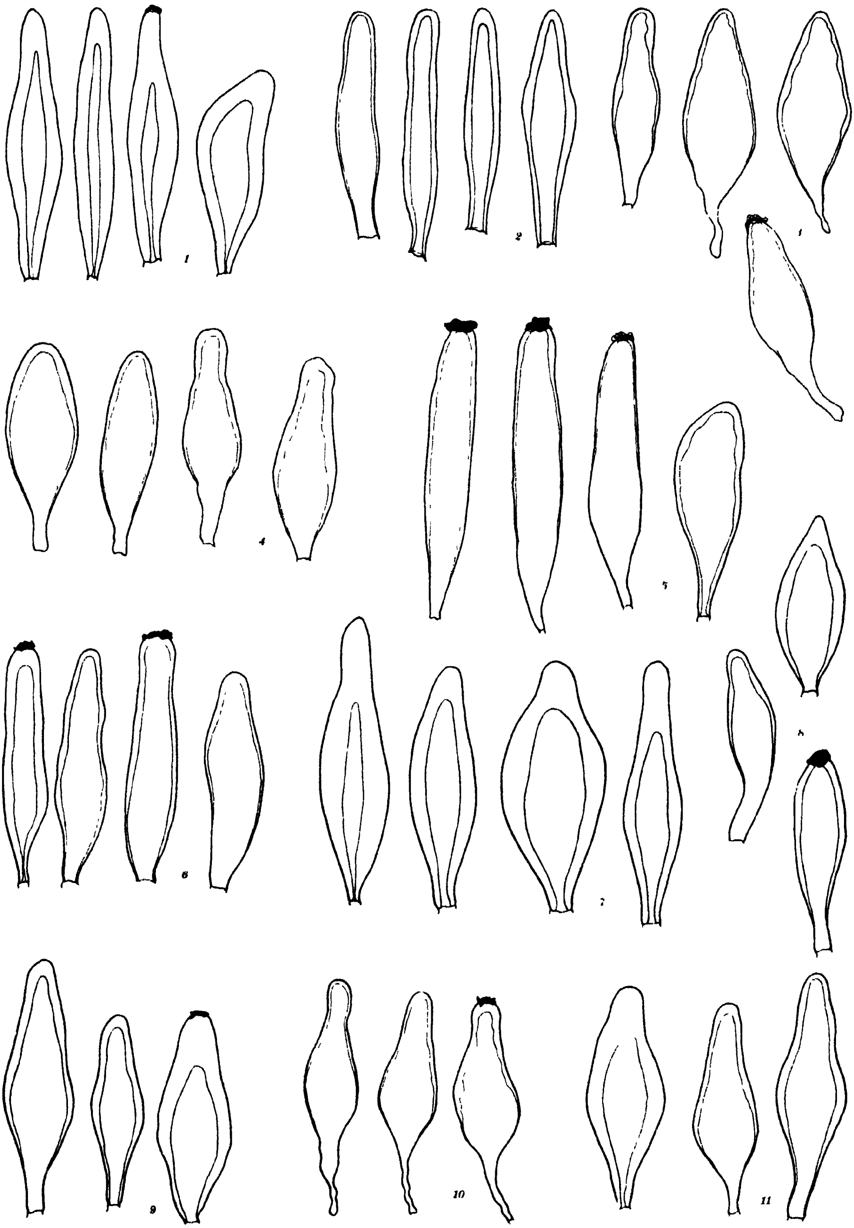
1. Inocybe multicoronata, cystidia
2. I xanthomelas, cystidia
3. I. subcarpta, cystidia
4. I. Rennyi, cystidia
5. I. astoriana, cystidia
6. I nodulosa, cystidia
7. I. alabamensis, cystidia
8. I. abundans, cystidia
9. I. castanea, cystidia
10. I. subfulva, cystidia
11. I. cicatricata, cystidia
12. I. geophylla f. perplexa, cystidia
13. I Davisiana, cystidia
14. I. Earleana, cystidia
15. I. ferruginosa, colored hymenial cells
16. I ferruginosa, cheilocystidia
17. I. lanatodisca, lactifers
18. I. brunnescens, cheilocystidia



Cystidia and lactifers in Inocybe

EXPLANATION OF PLATE IV

1. Inocybe olympiana, cystidia
2. I. siskiyouensis, cystidia
3. I. virgata, cystidia
4. I. rufidula, cystidia
5. I. pallidobrunnea, cystidia
6. I. ovalispora, cystidia
7. I. ochraceomarginata, cystidia
8. I. connexa, cystidia
9. I. subdestricta, cystidia
10. I. fuscodisca, cystidia
11. I. Kauffmani, cystidia



Cystidia in Inocybe

Inocybe olympiana, sp. nov. × 1

ADDITIONS TO THE FOSSIL FLORA OF SUCKER CREEK, OREGON *

HELEN V. SMITH

THE first collections of plant fossils reported from the leaf-bearing shales along Sucker (i.e. Succor) Creek were made by Lindgren (16) in 1898 in two localities: one near the Oregon-Idaho boundary line, where the old coach road crossed the creek; the other near the old Rockville stage depot. The fossil plants were studied by Knowlton, who correlated the seventeen species with the Miocene Payette formation. There were no further collections of fossil plants at Sucker Creek until 1921, when Chaney (9) explored several localities in the lower Snake River valley. As a result of his studies seventeen species were added to the known Payette flora. Since he did not list his plants by locality it is impossible to determine how many were from the four Sucker Creek beds studied.

Berry (4) later listed eleven species from the old Ballantyne Ranch, which lies along Sucker Creek and is partly in Oregon and partly in Idaho. A larger collection from this same region was studied by Brooks (5). In 1935 she reported twenty-eight species, thirteen of which had not been reported from the Payette previously. Arnold (1–3) has recently recorded ten additional species. In this paper thirty species are listed; of these, eleven have not been previously reported from Sucker Creek; one new species is described and one new combination proposed.

Few studies of the fossil fauna of Sucker Creek have been made. The only evidence of a fauna encountered in collecting the leaves consisted of occasional fragments of fish vertebrae. Scharf (19) studied seventeen animal fossils from a locality on Sucker Creek about nine miles north of Rockville. Fish vertebrae and ostracod shells indicated that deposition of at least part of the sediments had taken place in a body of water. His collections included bone

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fragments of a probably carnivorous mammal, rodents, mastodons, several types of horses and camels, and other animals. In speaking of the physical conditions indicated by the fauna he said that the presence of the browsing types were suggestive of a glade or forest environment, and the grazing forms indicated in addition an association of extensive grasslands.

Sucker Creek flows in a northerly direction near the Oregon Idaho boundary line. For most of the distance it is in Malheur County, Oregon, but the lower part is in Owyhee County, Idaho. It empties into the Snake River. The Sucker Creek valley is interrupted by a narrow canyon of igneous rock, which extends for several miles along the creek. Fossil leaf-bearing shales are abundant in a great part of the valley, but are, of course, not present in the canyon.

Collections of fossils for this study were made in both the upper and the lower valleys. Most of the collecting was done during the summers of 1931, 1932, 1934, and 1936, and over twelve hundred specimens were obtained. In general, the material was found along hillsides. It had weathered out and was scattered below the fossil-bearing ledge. The gray matrix is fine-grained, very hard, and weathers to a reddish or a brownish color. In a few places where the material was dug out of the ground the matrix was softer and lighter in color. In the lower valley collections were made at two principal localities, one of which is the old Ballantyne Ranch near where Sucker Creek crosses the state line. It was from these same beds that the material studied by Brooks was obtained. The second is two or three miles above the ranch house at a site near an abandoned coal mine. In the upper valley collections were made at a number of localities on both sides of the creek within three or four miles of the Rockville post office. These are all designated as coming from Rockville. Comparisons between collections from these localities would have no significance because of the scattered distribution of the specimens and because the leaf-bearing shales are more or less continuous for some distance along the creek. The Ballantyne Ranch locality and the one designated as the "coal mine" are considered to be separate since a small canyon intervenes between them. There does not appear to be any significant difference between the fossils secured at various localities.

For assistance in making the collections I am greatly indebted to my brother, Dr. Wendell V. Smith; to my father, Professor O. J.

Smith; and to Professor H. M. Tucker and many others. I am also grateful to Mrs. A. Sheridan for detailed information on the location of certain fossil beds and for many specimens which she collected. For suggestions and criticisms in the early stages of this study I am under special obligation to Dr. Ethel I. Sanborn; and for aid in the later studies, to Professor H. H. Bartlett, who has been most generous with suggestions and helpful criticism.

The type specimens are now in the Museum of Paleontology of the University of Michigan. Representative material has been deposited with the Cranbrook Institute of Science, and specimens loaned by the College of Idaho have been returned to it.

List of Species

PINACEAE

Pinus knowltoni Chaney (Pl. VII, Fig. 3). — Fragments of *Pinus* needles occurring in groups of two or three are referred to this species. The needles are rather slender, moderately rigid, and usually somewhat curved. None of the specimens are preserved for their entire length, but a number of the fragments are 5.5 to 6 cm. long. This fossil species has been compared with the knobcone pine, *P. attenuata* Lemm., which grows on the rocky ridges of southwestern Oregon and western California.

Sequoia Langsdorfii (Brnt.) Heer. (Pl V, Fig. 1). — Two leafy twigs collected near the Idaho Oregon boundary line in the lower part of the valley constitute the only evidence of *Sequoia* from Sucker Creek in the collection. The needles are pointed and fairly short and appear to twist at the base, as in the living *S. sempervirens* Endl. The presence of *Sequoia* in the Sucker Creek valley was noted in the first collections made there. Knowlton (in Lindgren, 16) studied three species, which he tentatively identified as *Sequoia* related to *S. gigantea* Decne., but I find no further definite reference to them in the literature. *S. Langsdorfii* has also been reported from the Weiser beds. It is abundant in the Latah of Idaho and Washington, but scarce in the Pliocene of California.

Glyptostrobus oregonensis R. W. Brown. — This species is represented only by fragments of leafy twigs from the Ballantyne Ranch locality; it has been previously recorded and discussed

by Brooks (5) as *G. linguaefolia* (Lesq.) Brooks. Since my material is apparently identical with that of Brooks it is referred to the same species under the new name, *C. oregonensis*, proposed by Brown (6).

TYPHACEAE

TYPHA LESQUEREUXI Cockerell. — This species has been reported by Berry (4) from the old Ballantyne Ranch. It is represented in this collection by fragmentary material, which resembles rather closely leaves of the cosmopolitan species *T. latifolia* L. found in marshes throughout temperate North America. Similar fragments of monocotyledonous leaves referred to *Typha* have been reported from Colorado, Wyoming,· Nevada, Washington, and Oregon.

SALICACEAE

POPULUS ALEXANDERI Dorf. — Two leaves somewhat smaller than those described from the Pliocene of California by Dorf (10) appear to belong to this species. They are quite unlike the other species of *Populus* from Sucker Creek in shape, nervation, and marginal characters.

POPULUS EOTREMULOIDES Knowlt. — This species was described in 1898 by Knowlton (12) from the Payette formation in the vicinity of Montour, Idaho, and since that time has been reported from a number of Upper Miocene formations. Brown (7) has recently figured an excellent specimen from Sucker Creek.

In discussing this species Knowlton pointed out its resemblance to *P. tremuloides* Michx. and indicated the supposed relationship in the name. His comparison was made with leaves of a seedling plant, which differ somewhat from those of normal mature plants. It seems preferable to compare the fossil specimens with leaves of mature plants when possible. As noted by Brooks (5) and Brown (7), there is evident similarity to *P. trichocarpa* T. & G., which occurs in western America along the coast ranges from southern Alaska to southern California. There is also marked resemblance between this species and *P. balsamifera* L. in size, shape, margin, texture, and venation. This latter species has a more northerly range, being found from Alaska to Hudson Bay and from Newfoundland south to northern New England and as far west as northern Idaho, Montana, and Oregon.

Both species occur along stream banks or around lakes in moist sandy soil in regions characterized by great humidity and precipitation.

POPULUS WASHOENSIS R. W. Brown. — A single specimen and its counterpart are included in the Sucker Creek material from Rockville. The leaf is almost orbicular in outline and has fairly strong blunt teeth. The venation is somewhat irregular and seems to indicate that the leaf was slightly abnormal. Its characteristics are so like those of the species, however, that little doubt remains as to the correctness of the identification. This species has been reported from the Upper Cedarville formation of Nevada, where, as was pointed out by Brown (8), it was confused with *P. Lindgreni* Knowlt. Among living species there is some resemblance to *P. grandidentata* Michx.

SALIX INQUIRENDA Knowlt. (Pl. VI, Fig. 3). — A linear-lanceolate leaf of this species from Rockville shows excellent preservation. It is narrower and longer than any specimen so far figured, being only 1.5 cm. wide at the widest point and somewhat over 16 cm. long. Among living species it is close to *S. lasiandra* Benth., a wet-soil plant of the middle altitudes extending from British Columbia to southern California west of the Sierra Nevada. Brown (7) has recently placed a number of species in synonymy with this one. All these differ from the Rockville specimen in being broader.

JUGLANDACEAE

CARYA EGREGIA (Lesq.) La Motte (Pl. VII, Fig. 1). — This species had been compared with *C. Cuthberti* Bartlett (Pl. VII, Fig. 4) by the author, but since there were only two detached leaflets available for study some hesitation was felt in making the generic change from *Juglans*. The recent work of La Motte (14) in which he figures the compound leaves and a number of leaflets seems to settle the question conclusively. He compared the fossil leaves with those of *C. glabra* Sweet and *C. alba* K. Koch. Since the associated wood was found to be more like *C. ovata* K. Koch he chose this species as the nearest living equivalent.

C. egregia was described in 1878 as *Juglans egregia* Lesq. from the Auriferous Gravels of California and has since been reported from a large number of western Miocene localities and from the Eocene of Alaska.

BETULACEAE

BETULA FAIRII Knowlt. — Brown (7) has grouped under this name several formerly distinguished species of *Betula* and has compared the fossil species with the Chinese *B. luminifera* Winkler. Brooks (5) reported this species from the old Ballantyne Ranch as *B. Largei* Knowlt.

FAGACEAE

CASTANOPSIS CONVEXA (Lesq.) Brooks (Pl. II, Fig. 7; Pl. V, Fig. 7). — This species constitutes a conspicuous element of the Sucker Creek flora. As described by Brooks (5), it includes leaves formerly designated under a number of names and appears to contain some types that should be kept distinct. The specimens in my collection referred to this species are those that conform to the description of *Quercus convexa* given by Lesquereux (15). That these specimens represent the genus *Castanopsis* and resemble the living *C. sempervirens* Dudley seems very probable.

QUERCUS BROWNI Brooks (Pl. II, Figs. 2–4, 6). — This species is represented by a number of well-preserved complete or nearly complete leaves. The variation from the margin that is entire to the spiny-toothed margin is well shown. *Q. Browni* is characterized by its small size, oblong-ovate to elliptical or slightly obovate outline, and the rather numerous close-set parallel veins. It appears to represent a species distinct from the somewhat similar *Q. Traini* MacG. from Trout Creek. *Q. Browni* is known from the Weiser beds also, where it has been reported from three localities. It is similar to the living species *Q. chrysolepis* Lieb. from the Pacific coast.

QUERCUS CONSIMILIS Newb. — Leaves that appear to agree in all particulars with figures and descriptions given by Newberry (18) for this species are included here. A number of different dispositions of this type of leaf have recently been made by paleobotanists, but until someone makes a critical study of a large number of fossils and similar living species, I prefer to use the original name and definition.

QUERCUS SIMULATA Knowlt. — This, like the species above, constitutes an important element of the Sucker Creek flora. A number of well-preserved lanceolate leaves, with entire or nearly entire margins, are included in it. Brooks (5) has suggested a

transfer to the genus *Castanopsis*. Further study of this proposal is necessary.

QUERCUS TRELEASII Berry (Pl. VI, Fig. 2). — Brown (8) has recently placed this and a number of other species in synonymy with *Sophora spokanensis* Knowlt. He studied a series of specimens in the United States National Museum, but their specific identity or similarity is not evident from the published figures and descriptions. Since this series is not compared with any living species, I consider it preferable to retain *Q. Treleasii* as distinct. The fossil leaves from Sucker Creek show a decided likeness to those of the living *Q. imbricaria* Michx., the shingle oak of the eastern states.

QUERCUS SP., cupules and acorn (Pl. V, Figs. 2–3). — The two *Quercus* cupules and the acorn are figured merely to show their presence in the collection. It is not possible to identify them as being the same species, or the same as any species based on leaves.

ULMACEAE

Ulmus owyheensis, sp. nov. (Pl. VI, Fig. 4). — Leaves ovate, broadest just below the middle, tapering slightly to the rounded asymmetric base and more abruptly to the acute-acuminate apex; margin dentate, teeth simple; midrib stout, tapering toward the apex; secondaries 15–16 pairs, subopposite or alternate, entering the teeth directly or after forking near the margin; secondaries in upper portion of blade straight, the lower ones often curved slightly, lowest pair giving off 3 or 4 abaxial tertiaries that end in the margin at base of leaf; remainder of tertiary venation obsolete; length 7.5 cm., width 4 cm.; texture membranaceous. Type, Mus. Pal., Univ. of Mich., No. 20017.

This species cannot be matched by leaves of any living species studied. The various characteristics can be found, however, in species of *Ulmus*. Among other genera examined *Planera*, *Zelkova*, and *Chaetoptelea* exhibit some similar characteristics, and all include species that may have simple teeth. These leaves usually differ from the Sucker Creek specimens in venation, shape, and size.

Two small-leaved Asiatic species, *U. parvifolia* Jacq. and *U. pumila* L., are characterized by having simple serrate margins and only slightly uneven bases. Typically the North American

species of *Ulmus* are coarsely doubly serrate and have very uneven bases. Some leaves of *U. americana* L., however, have simple teeth in the upper part of the blade. The shape and the venation of leaves of *U. racemosa* Thomas are very similar to those of this fossil species. The veins are close-set and many curve near the base; the leaves are ovate, usually widest about the middle. The teeth may not be conspicuously doubly serrate, and they often give the impression of being single.

Among fossil species this does not resemble the small singly serrate species as closely as it does *U. speciosa* Newb., as figured by Newberry (18, pl. 45, fig. 4). In his figure many of the teeth are shown as being simple, and the secondary teeth, where present, are not prominent. In the description, however, the margin is said to be coarsely doubly serrate. The venation is essentially the same, but the typical coarse tertiary venation usually shown for this species is not evident in my specimens. Under the circumstances I believe it is best to keep these species distinct.

BERBERIDACEAE

MAHONIA RETICULATA (MacG.) R. W. Brown. — This species was first reported from Trout Creek and has since been recorded from Sucker Creek and Tipton, Oregon. The shape and the nervation relate it to the modern *M. aquifolia* Nutt., but the number of marginal teeth is greater in the living species. For the synonymy of this species, which was originally described as *Clematis reticulata* MacG., see Brown (7).

MAHONIA SIMPLEX (Newb.) Arnold (Pl. V, Fig. 5; Pl. VI, Fig. 5). — This has been the species most frequently reported from Sucker Creek; it is quite abundant in the vicinity of Rockville. Among living species it is very close to the Japanese *M. japonica* Thunb.

MAHONIA TRAINII Arnold (Pl. III, Fig. 2). — This species was indicated as new in the writer's manuscript some time ago, but has recently been published by Arnold (1), whose material was collected from the same bed. It is known only from the upper Sucker Creek valley in the vicinity of Rockville. In shape and venation it resembles *M. nervosa* Nutt. In shape it is also like *M. lanceolata* Fedde, but is smaller and has fewer marginal teeth. The two modern western species of *Mahonia* are separated on

the basis of venation. *M. nervosa*, represented by the fossil form *M. Trainii*, has palmate venation, whereas *M. aquifolia* and *M. reticulata* have pinnate.

PLATANACEAE

PLATANUS DISSECTA Lesq. (Pl. V, Fig. 4). — This common Miocene species is well represented at all localities along Sucker Creek. The leaves are conspicuously trinervate, with rather prominent undulate pinnate veins in the upper part of the blade. Although *P. dissecta* is often compared with *P. racemosa* Nutt. of the western United States, I believe that it is much more like the eastern *P. occidentalis* L.

PLATANUS REGULARIS Knowlt. (Pl. IV, Fig. 2). — Knowlton (13) described this species from a single specimen from an unknown Tertiary locality after the specimen had been lost. There are four specimens in the Sucker Creek collection that appear to belong to this species. The leaves are characterized by their broadly ovate shape and by the branches of the lateral palmate veins, which are of approximately the same strength as the pinnate veins and end in marginal dentations of equal strength. The base is cordate or subcordate; the primary veins in some specimens appear to be naked; the secondaries are opposite, subopposite, or alternate; the tertiaries arch and may be either anastomosing or percurrent. Some of the leaves are quite large; the largest is 19 cm. long and 18 cm. broad.

Although the aspect of these leaves is typically that of *Platanus*, no living species studied is characterized by the type of venation in which the secondaries arising from all three of the primary veins are of approximately the same strength. The specimens are easily separated from *P. dissecta*, with which they have much in common.

Neotype, Mus. Pal., Univ. of Mich., No. 20016.

MELIACEAE

CEDRELA OREGONIANA (Lesq.) R. W. Brown (Pl. III, Fig. 7; Pl. V, Fig. 6). — With the exception of the leaf species that has been referred to *Apocynum indiana* MacG., the synonymy given for this species by Brown (8) seems plausible. Arnold (2) recognized two leaf species from the Rockville beds, but from material

collected from the same localities I have been able to distinguish only one. Most of the specimens are from several beds in the upper part of the Sucker Creek valley.

ACERACEAE

ACER BOLANDERI Lesq. (Pl. III, Fig. 3). — A small leaf of this species is illustrated along with a small nonserrate leaf of *A. Buergerianum* Miq. (Pl. III, Fig. 4) to show their similarity.

ACER OSMONTI Knowlt. (Pl. III, Figs. 1, 6; Pl. IV, Fig. 1). — Numerous leaves of this species are included in my collection. Most of the specimens are well preserved, and several are complete. Among living species this finds its closest relationship with *A. saccharinum* L. of the eastern United States.

ACER SCOTTIAE MacG. — This species, which was described from Trout Creek, is characterized by having seven primary veins, broad lobes, shallow rounded sinuses, and a very thin texture. No samaras belonging to it have been collected at Sucker Creek. *A. Scottiae* has as a living equivalent *A. pictum* Thunb., which grows in Manchuria, Japan, and China.

ARALIACEAE

Oreopanax dissecta (Lesq.), comb. nov. (Pl. I; Pl. II, Figs. 1, 5). — *Aralia dissecta* Lesq., U. S. Geol. Surv., *Terr. Rep.*, 8: 176, pl. 35, fig. 1. 1883; *Quercus precoccinea* Brooks, *Annals Carnegie Mus.*, 24: 292, pl. 16, fig. 1. 1935; *Oreopanax precoccinea* (Brooks) Arnold, *Contrib. Mus. Pal., Univ. of Mich.*, 5: 98, pl. 10, figs. 1–5. 1937.

This fine species was described as an *Aralia* from Florissant, and apparently is known only from that locality and from Sucker Creek. In an unpublished manuscript I suggested in 1932, after a study of some large fragments of these leaves, that the species should more properly be referred to *Oreopanax*. Brooks (5), recognizing the resemblance of the fragments to certain red oaks, described a specimen from the lower Sucker Creek valley as *Quercus precoccinea*. Arnold (3), also studying specimens from Sucker Creek near Rockville, likewise placed the species in *Oreopanax*, but did not recognize its identity with *A. dissecta*. Careful study indicates that the Sucker Creek material and the large leaf from Florissant, as described and figured,

represent the same species. The new combination *O. dissecta* is proposed.

The only major distinction between the Sucker Creek material and that from Florissant is in the degree of dissection of the leaves. Most of the Oregon material is digitately compound, whereas the other is deeply dissected, but not compound. The venation, general aspect, shape of the lobes, spiny teeth, and other features are all similar. Included in my collection is a small leaf having only trilobes, which, however, are merely toothed and not lobed. This leaf has the same venation and the very broadly expanded petiole base that is shown on the larger leaves. Since both compound and deeply lobed leaves often occur on the same plants in the Araliaceae and since both have been found in association in the Sucker Creek beds I believe that only one species is represented. *O. Conditi* La Motte from 49 Camp, Nevada, may belong to the same species.

ERICACEAE

ARBUTUS IDAHOENSIS (Knowlt.) R. W. Brown. — This species was reported from the Ballantyne Ranch locality by Brooks (5). The Sucker Creek material does not differ appreciably from that of the Weiser beds referred to *A. Mathessei* Chaney by Dorf (11) and Smith (20). My reference of that material to Chaney's species was prompted by the statement made by La Motte (14) that the narrow forms, such as these, and the broad form, such as that described by Chaney, could be matched by variants of the same living species, *A. Menziesii* Pursh. However, after a study of the leaves of the living species in the field it is evident that the elongate-narrow leaves are produced at the ends of the branches and are relatively uncommon. As a result, it seems best to recognize the two species, *A. Mathessei* and *A. idahoensis*.

APOCYNACEAE

APOCYNUM INDIANA MacG. (Pl. VI, Fig. 1; Pl. VII, Fig. 2). — *Sapindus oregoniana* Knowlt. — La Motte, Carnegie Inst. Wash., Publ. 455, pl. 3, fig. 4 (only). 1935.

One of the two specimens included in the Sucker Creek collection is considerably larger than the species as described from Trout Creek by MacGinitie (17), but does not differ in essentials.

It has a slightly more undulate margin and less prominent secondaries, but the general aspect, shape, and broad asymmetrical base identify it beyond a reasonable doubt. The smaller specimen is well within the limits.

There is a striking resemblance between the small specimen and that figured by La Motte and referred to above. The comparison is equally striking with the species as figured by MacGinitie. There is almost no possibility that the fossils represent *Apocynum.* Brown (8) has placed the names in synonymy with *Cedrela oregonensis* (Lesq.) R. W. Brown. I do not believe that they should be so referred and, in default of a more likely disposition, I prefer to retain a name which is definite in specific application, even if it is undoubtedly incorrect as to the genus.

CAPRIFOLIACEAE

SYMPHORICARPOS ELEGANS (Lesq.) H. V. Smith (Pl. III, Fig. 5). — This species is known from Florissant, Hog Creek, and Sucker Creek. It is related to the common snowberry, *S. albus* (L.) Blake.

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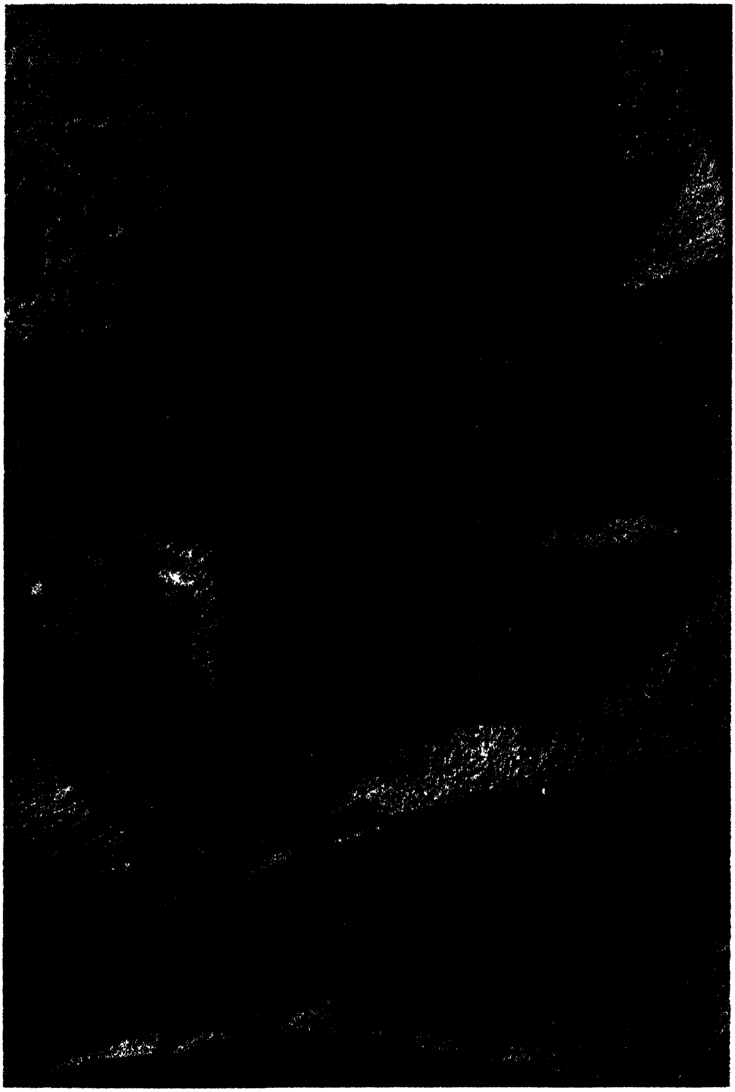


Oreopanax dissecta (Lesq.) H. V. Smith

FIGS. 1, 5. *Oreopanax dissecta* (Lesq.) H. V. Smith
FIGS. 2–4, 6. *Quercus Browni* Brooks
FIG. 7. *Castanopsis convexa* (Lesq.) Brooks

EXPLANATION OF PLATE III

FIGS. 1, 6. *Acer Osmonti* Knowlt.

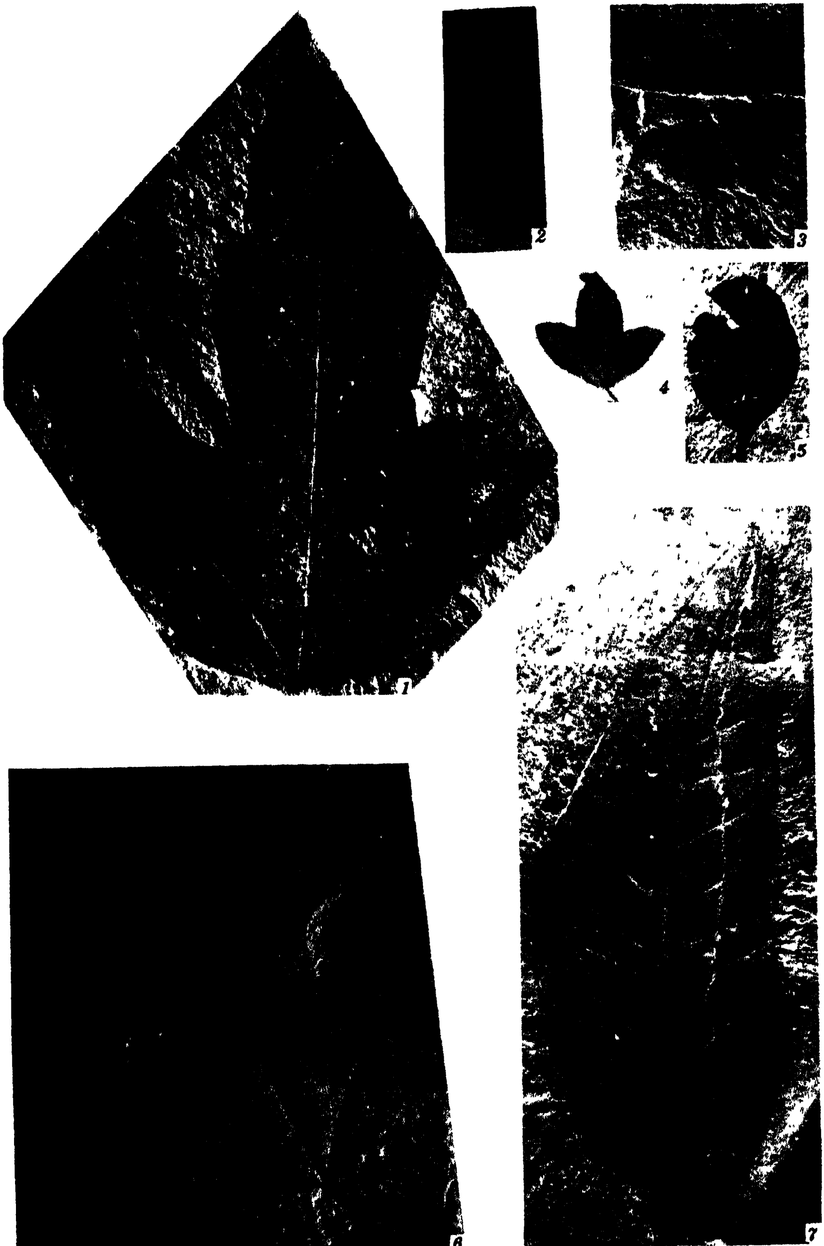
FIG. 2. *Mahonia Trainii* Arnold.

FIG. 3. *Acer Bolanderi* Lesq.

FIG. 4. *Acer Buergerianum* Miq. Specimen from the Botanical Gardens, University of Michigan.

FIG. 5. *Symphoricarpos elegans* (Lesq.) H. V. Smith.

FIG. 7. *Cedrela oregoniana* (Lesq.) R. W. Brown.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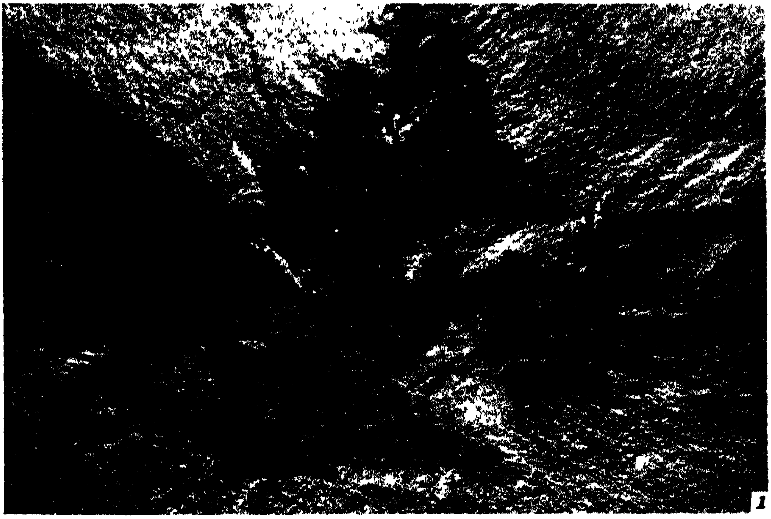

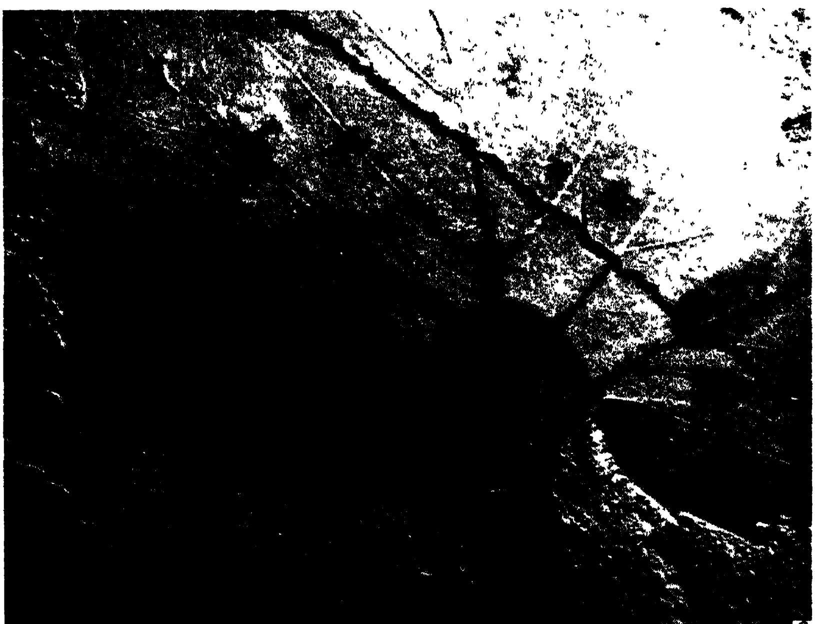

FIG. 1. *Acer Osmonti* Knowlt

FIG. 2. *Platanus regularis* Knowlt.

EXPLANATION OF PLATE V

FIG. 1. *Sequoia Langsdorfii* (Brgt.) Heer

FIG. 2. *Quercus sp.* acorn

FIG. 3. *Quercus sp.* cupules.

FIG. 4. *Platanus dissecta* Lesq.

FIG. 5. *Mahonia simplex* (Newb.) Arnold

FIG. 6. *Cedrela sp.* capsules

FIG. 7. *Castanopsis convexa* (Lesq.) Brooks

FIG. 1. *Apocynum indiana* MacG.
FIG. 2. *Quercus Treleasii* Berry
FIG. 3. *Salix inquirenda* Knowlt.
FIG. 4. *Ulmus owyheensis*, sp. nov., H. V. Smith
FIG. 5. *Mahonia simplex* (Newb.) Arnold

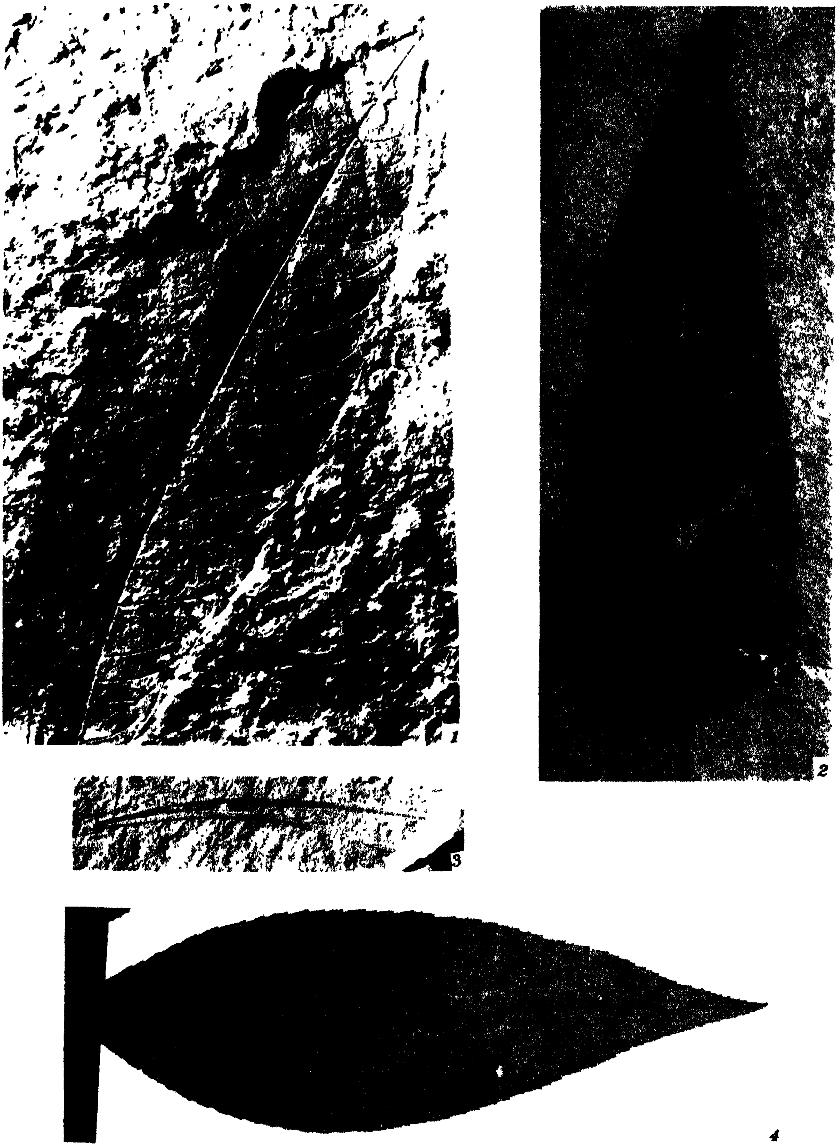

FIG. 1. *Carya egregia* (Lesq.) La Motte

FIG. 2. *Apocynum indiana* MacG.

FIG. 3. *Pinus Knowltoni* Chaney

FIG. 4. *Carya Cuthberti* Bartlett. Specimen from West Augusta, Georgia, in the Herbarium of the University of Michigan

UNUSUAL CHYTRIDIACEOUS FUNGI *

FREDERICK K SPARROW, JR.

MANY members of the Chlorophyceae and the Heterokontae are frequently attacked by species of phycomycetous fungi belonging to the order Chytridiales. Some algae, when first invaded, appear to be in a healthy condition, whereas in others unmistakable evidences of moribundity are visible, and the extraneous organism is probably only weakly, if at all, parasitic on them. Certain of these "chytrids," as they are called, may also be induced to live on boiled filaments of their apparent "host," and of these it can be said with certainty that they are capable of living saprophytically.

With one exception the fungi about to be described were collected at Crooked Lake, Washtenaw County, Michigan, on October 15, 1937. *Rhizophidium granulosporum* Scherff was obtained in material of *Tribonema bombycina* collected by W F Jewell at Half Moon Lake, Washtenaw County, Michigan, April 1, 1937 The collection at Crooked Lake consisted almost entirely of *Cladophora spp.* and *Oedogonium spp.* and was remarkable because it yielded five new species of chytridiaceous fungi as well as several already described but little-known forms Certain of these will be dealt with in a forthcoming paper [1] but two species, together with the Rhizophidium previously mentioned, will be discussed here.

Diplophlyctis laevis Sparrow

F. K. Sparrow, *Occ Papers Boston Soc. Nat Hist*, 8: 296. 1937.

Sporangium broadly or irregularly pyriform, 20 35 μ long by 13 35 μ in diameter at the base; with a subspherical subsporangial apophysis 4-5 μ in diameter, from which one or several stout branching rhizoids emerge; with a broad tapering discharge tube of variable

* Papers from the Department of Botany of the University of Michigan, No. 657

[1] "Chytridiaceous Fungi with Unusual Sporangial Ornamentation," *Am Journ. Bot.*, 25: 485. 1938

length (up to 50 μ), the tip of which penetrates the host wall and generally protrudes only slightly beyond it. Zoöspores spherical, 7 μ in diameter, with a single oil globule 3 μ in diameter and a posterior cilium 30 μ long. Resting spores spherical or ellipsoidal, 11–18 $\mu \times$ 12–18 μ, with a smooth wall about 2 μ thick surrounding the contents, in which are many oil globules of approximately the same size, and a spherical apophysis 5–7 μ in diameter; germination not seen.

Saprophytic in *Cladophora sp.*, Crooked Lake, Washtenaw County, Michigan, Oct. 15, 1937.

This fungus occurred in obviously dead and whitened filaments of Cladophora, often in company with *Chytridium Schenkii* and *Catenaria sp.* Growth was maintained for a time on boiled filaments of Cladophora.

D. laevis differs strikingly from *D. intestina* (Schenk) Schroeter, the only other member of the genus, in having a smooth outer wall on the resting spore (Pl. I, Figs. 12–14), rather than one thickly beset with spines. A careful search was made under high magnifications for such spines on the many resting spores formed in *D. laevis*, but none was found. Occasionally smooth-walled specimens are produced by *D. intestina*, but in the new species no other type is produced.

The establishment of the thallus (Pl. I, Fig. 1), the development of the sporangia (Pl. I, Figs. 2–6), and the discharge of the zoöspores upon the deliquescence of the apical papilla of the discharge tube (Pl. I, Figs. 7–11) are not essentially different from those found in *Diplophlyctis intestina* by Karling (1). In all probability the variations in the shape of the sporangium and the lateral position of the apophysis are due to restrictions of space imposed upon the fungus by the relatively narrow Cladophora cells.

Rhizophidium chaetiferum Sparrow

F. K. Sparrow, *Occ. Papers Boston Soc. Nat. Hist.*, 8: 295. 1937.

Sporangium spherical, rarely subspherical, colorless, predominately 12 μ in diameter, the upper two thirds of the wall covered with long slender branched or unbranched hairs up to 30–50 μ in length. Zoöspores spherical, uniguttulate, 3 μ in diameter, with a single posterior cilium, discharged upon the deliquescence of an apical or a subapical papilla, the aperture thus formed widening considerably

after emergence of the spores; rhizoidal system delicate, profusely branched, arising from the tip of the slender penetration tube. Resting spore extramatrical, spherical or slightly subspherical, 12 μ in diameter, with a thickened wall covered by long hairs or short processes or both; contents with a single large oil globule; rhizoidal system branched; germination not seen.

Saprophytic on *Cladophora spp.* and *Oedogonium spp.*, Crooked Lake, Washtenaw County, Michigan, Oct. 15, 1937.

In the development and ornamentation of its sporangia *Rhizophidium chaetiferum* (Pl. II, Figs. 1-9) resembles *Chytridium chaetophilum* Scherff., *Rhizophidium* v. *Mindeni* Valkanov, and *Phlyctochytrium chaetiferum* Karling. It differs from all of these, however, in essential features. The sausage-shaped sporangium of *C. chaetophilum* possesses only a peglike intramatrical part, which barely pierces the cell wall of the host; the method of sporangial dehiscence is not clearly understood, but evidently it involves the bursting apart of the sporangium rather than, as in *R chaetiferum*, the deliquescence of a part of the wall (Pl. II, Figs. 11 12). The sporangia of *R.* v. *Mindeni* resemble closely those of *C. chaetophilum*, and elsewhere (3) I have considered the two identical. Though faint lines in Valkanov's figure 6 (4) seem to suggest the presence of a rhizoidal system, neither this structure nor the method of sporangial dehiscence nor the zoöspores are known. *Phlyctochytrium chaetiferum* Karling has sporangia somewhat similar to those of *R. chaetiferum*, but is distinctive because of the formation of a subsporangial apophysis and a prominent blunt-rounded discharge papilla. It is interesting to note that Karling's species occurs in abundance on Cladophora in the Huron River, whereas it is seemingly completely absent in Crooked Lake; at the latter site its place is taken by *R. chaetiferum*.

Resting spores of the present species were found in abundance. As a rule they, like the sporangia, possessed delicate radiating hairs on the outer wall (Pl. II, Fig. 10). These were generally somewhat shorter than those on the sporangia, but resembled them in other respects. On occasional resting spores there were also formed short rodlike protuberances (Pl. II, Fig. 13) similar to those found on *Rhizophidium setigerum* Scherff. In contrast to the latter species, however, known only from the resting stage, no companion ("male") cell was present. The resting spores of *R. chaetiferum* appear, therefore, to have been asexually formed.

Rhizophidium granulosporum Scherff.

On material of *Tribonema bombycina* collected at Half Moon Lake, Washtenaw County, there developed a chytrid which I take to be Scherffel's species. It was associated with *Polyphagus parasiticus* Nowak. and *Chytridium Confervae* (Wille) Minden. None of these species has hitherto been reported from this country.

The sporangia of *R. granulosporum* (Pl. II, Figs. 15, 22) were pyriform, with a delicate smooth wall, and were 7–9 μ high by 5–7 μ in diameter, somewhat smaller than those reported by Scherffel (12–14 μ high by 9 μ in diameter). Subspherical sporangia 6–8 μ high by 7–9 μ in diameter were also found on the alga (Pl. II, Figs. 14, 16), but whether or not they belong to *R. granulosporum* is not certain. At the base of the pyriform sporangia and within the alga there could occasionally be detected a very tenuous sparingly branched rhizoidal system (Pl. II, Fig. 22). Scherffel (2) was unable to observe this phase of his species, and in the present material it was visible only wherever the host cell was nearly exhausted of its contents. The sporangia were discharged after the deliquescence of a subapical or, occasionally, lateral papilla. Through the pore thus formed the posteriorly uniciliate, uniguttulate, somewhat ellipsoidal zoöspores emerged (Pl. II, Fig. 15). These were about 3 μ long by 2 μ in diameter.

The resting spores of *R. granulosporum* are formed as the result of a sexual process which involves the fusion of the contents of two thalli. In the Hungarian material this process was accomplished either by the swarmer settling down on the already established "male" plant or by the two plants developing side by side on the surface of the host cell wall. In either case the contents of one plant passes into the other, which then increases in size and becomes the resting spore. The empty cyst of the contributing thallus remains attached to the greatly enlarged receptive plant. In the Michigan material both conjugating thalli appeared to develop on the host wall (Pl. II, Figs. 17, 19, 20, 25), although in two instances (Pl. II, Figs. 18, 24) it is possible that the receptive thallus made contact only with the "male" plant. A third type of conjugation is shown in Plate II, Figure 21, where the "female" alone has become attached to the algal cell. Rarely, a polyandrous condition was observed (Pl. II, Fig. 23). The mature resting spores are exactly spherical, 6–7 μ in diameter,

with a thickened wall, the outer surface of which is moderately covered with short spinelike outgrowths. These protuberances appear soon after fertilization and before thickening of the wall of the resting spore has been initiated (Pl. II, Figs. 18, 23–24). In the contents of the mature spore there is a single large colorless globule. The adherent "male" cell, which is empty save for a single small globule, is smooth-walled, spherical, and about 3 μ in diameter. Germination of the resting spores has not been observed.

Acknowledgment is made to the Faculty Research Fund of the University of Michigan for financial aid given in connection with the preparation of this paper.

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NOTE

All figures were drawn from living material with the aid of the camera lucida Pl. I, × 750. Pl. II, Figs. 1–13, × 750; Figs. 14–25, × 1000

EXPLANATION OF PLATE I

Diplophlyctis laevis Sparrow

FIG. 1. Early stage in the formation of the thallus. The empty cyst of the infecting zoospore is shown on the outside of the cell wall of the Cladophora, connected by the penetration tube with the intramatrical branched rhizoidal system, the apophysis, and the terminal globular portion, which becomes the sporangium

FIG. 2. Immature sporangium, with discharge tube piercing the wall of the Cladophora cell. The rhizoidal system is still continuous with the sporangium and is carrying material to it

FIG. 3. Mature sporangium, with globules of zoospores formed and rhizoids empty

FIG. 4. Nearly mature sporangium. The rhizoidal system is cut off from the sporangium by a cross wall. Note that the apex of the discharge tube has already deliquesced

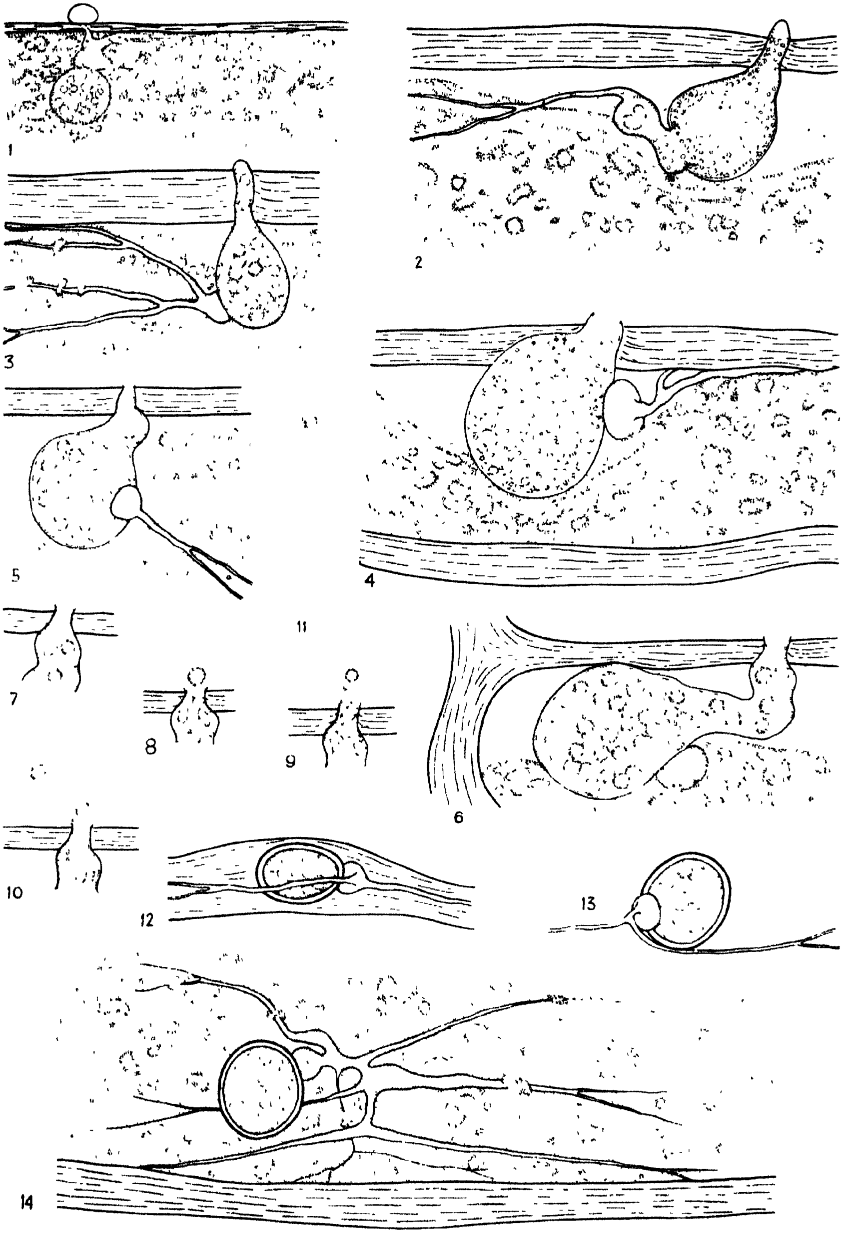
FIGS. 5–6. Mature sporangia, showing differences in shape

FIGS. 7–10. Stages in the liberation of the zoospores

FIG. 11. Single zoöspore

FIG. 12. Resting spore formed in wall of Cladophora

FIGS. 13–14. Resting spores free in the Cladophora cell



Diplophlyctis laevis Sparrow

EXPLANATION OF PLATE II

Rhizophidium chaetiferum Sparrow

FIGS. 1–5. Stages in the establishment of the thallus and successive development of the hairs. In Figure 1 the zoöspore has come to rest on the surface of the Cladophora cell. In Figure 2 a penetration tube has pierced the wall, and a single unbranched hair has developed on the extramatrical enlarging body

FIGS. 6–7. Immature thalli

FIG. 8. Mature sporangium

FIG. 9. Empty sporangium, with nearly apical discharge pore

FIG. 10. Usual type of resting spore

FIG. 11. Emergence of the first zoospore from the sporangium

FIG. 12. Zoospores discharged and exit pore distended

FIG. 13. Unusual type of resting spore, bearing hairs as well as short rods

Rhizophidium granulosporum Scherff.

FIG. 14. Subspherical sporangium of *R. granulosporum* on Tribonema

FIG. 15. Discharge of pyriform type of sporangium

FIG. 16. Subspherical sporangium, with lateral exit pore and rhizoidal system

FIG. 17. Early stage in conjugation of thalli, in which both plants make contact with the algal wall. The rhizoid of one plant may be seen in the transverse wall of the alga

FIG. 18. Immature resting spore, in which the "male" alone appears to have made contact with the host

FIGS. 19–20. Mature resting spores, with attached "male" plants, both of which seem to have made contact with the algal cell

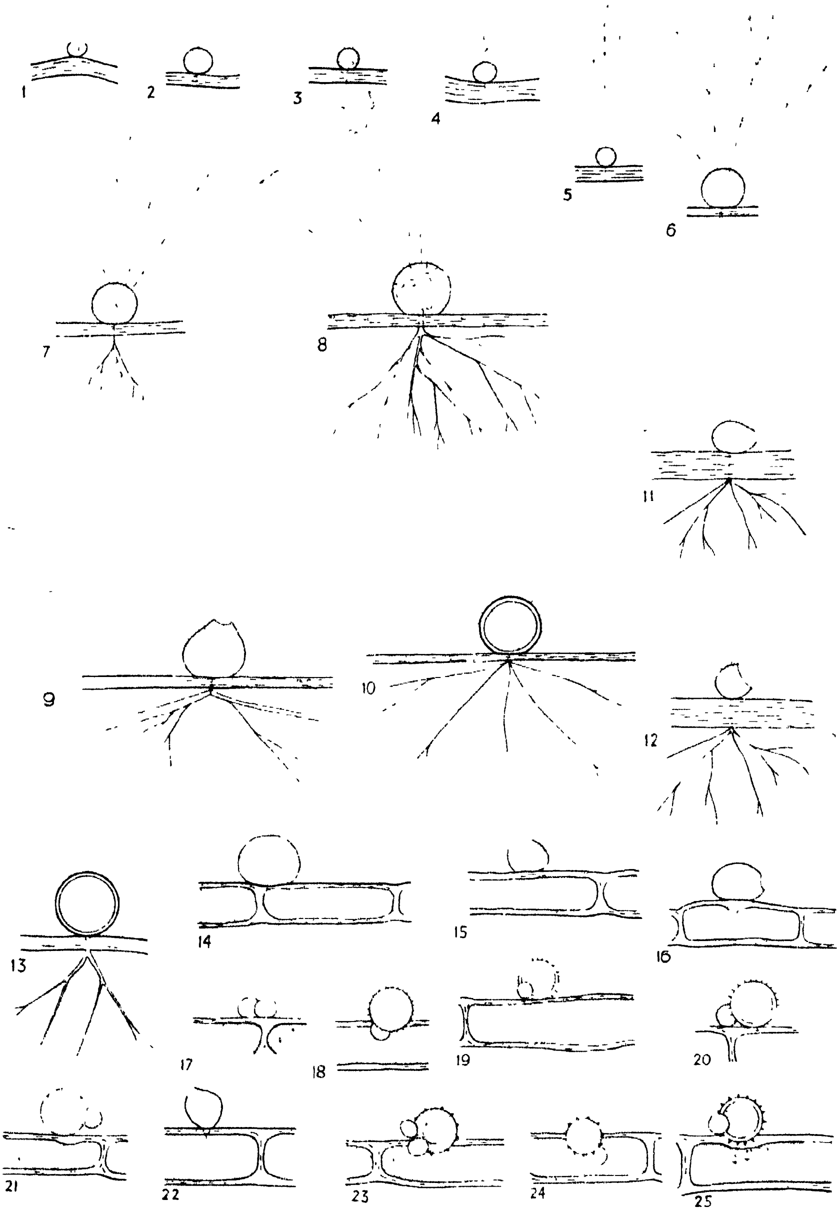
FIG. 21. Immature receptive thallus on a Tribonema cell, with the "male" attached to it

FIG. 22. Empty pyriform sporangium, showing nature of rhizoidal system

FIG. 23. Immature resting spore, with two male plants attached to it (polyandrous)

FIG. 24. Example of a receptive thallus which seems to be attached to the "male" cell only

FIG. 25. Mature resting spore and "male" cell, both on the host wall



Rhizophidium chaetiferum Sparrow (1–13) and *R. granulosporum* Scherff. (14–25)

ALGAE COLLECTED BY THE "HASSLER," "ALBATROSS," AND SCHMITT EXPEDITIONS

II. MARINE ALGAE FROM URUGUAY, ARGENTINA, THE FALKLAND ISLANDS, AND THE STRAIT OF MAGELLAN

WM. RANDOLPH TAYLOR

INTRODUCTION

SEVERAL years ago the writer (1930) reported on a group of Brazilian algae collected by the "Hassler," "Albatross," and Schmitt expeditions. It was the largest group of specimens brought by these expeditions from any one country. It is proposed in the present account to deal with the rest of the eastern South American material, that from the Falkland Islands and the Strait of Magellan. Some attention has already been given (Taylor, 1930; Howe and Taylor, 1931) to the history of these cruises, but a brief résumé is appropriate here. In December, 1871, the "Hassler," a United States Coast Survey steamer, left Boston for San Francisco en route for a new station on the west coast; it carried a group of scientists under the direction of Louis Agassiz. The marine algae were collected by Thomas Hill (Agassiz, 1872). A very short general account of the trip may be found in Agassiz's biography (E. C. Agassiz, 1885) and in reports written by Agassiz (1872, p. 216 ff.) and an anonymous author (1872, p. 210 ff.). The "Albatross," a United States Bureau of Fisheries steamer under the command of Z. L. Tanner (1888, p. 371), with L. H. Lee in charge of the scientific staff, made a similar trip in 1887–88. For the use of the "Hassler" and the "Albatross" material the writer is indebted to Drs. C. W. Dodge and his successor, D. H. Linder, curators of the Farlow Herbarium of Harvard University, where most of the material is retained. Dr. Waldo L. Schmitt, under the Walter Rathbone Bacon Scholarship, made two

South American trips in 1925-27. His material, which was sent back in bulk in dilute formalin, was sorted and mounted after receipt, and the major portion of it deposited in the United States National Herbarium.

In addition to these collections a few specimens sent from Uruguay for determination by Dr. G. W. Herter and Miss Phoebe Jordan are included, since they hardly justify separate publication, but they do considerably increase the value of the small collection made there by Dr. Schmitt. Parts of these collections are in the writer's herbarium.

Accounts of the algae of Uruguay and eastern Argentina are almost lacking; the only substantial one with which the writer is familiar is that of Howe (1931, p. 605). It is evident that the flora is different from that of most of Brazil as compiled by the present writer, with the characteristically tropical types practically absent, though some wide-ranging genera, such as Codium, are represented as far south as the Falkland Islands.

The algae of the Falkland Islands are much better known than those of the mainland coast farther to the northwest. The history of early collections is well summarized by Cotton (1915, p. 143). Since no attempt is made here to prepare a complete list, it is unnecessary to call attention to all of these. From our standpoint the most important collections are those made by the "Erebus" and "Terror" Expedition (Hooker and Harvey, 1845, 1845a-1847), by Skottsberg (1907), and by Vallentin (Cotton, 1915). It is probable that the general character of the flora of these islands is quite as well known as that of the Strait of Magellan, which is very similar.

It is not surprising that the flora of the region of the Strait of Magellan is far better known than that of the northern Patagonian coast. This coast has had relatively little to attract vessels; until the development of the Panama Canal the Strait was a very important route, and even now has considerable traffic, thanks to sheep raising and other industries. A number of expeditions and collectors have brought back material from the Strait, but no student of algae has spent much time there, and no doubt many details of the flora are yet to be completed. It is rather curious that, in spite of the severe working conditions, no comprehensive study of the Strait algae has been attempted, for other places in the southern area less often visited have been relatively well reported. In the

absence of a catalog of the algae of the Strait itself, the best summary available is that of Gain (1912), which relates, in tabular form, the plants of various south temperate and antarctic areas. The list shows the lack of many species found on the colder antarctic shores and the presence of a few wide-ranging genera more typically tropical, such as Codium and Colpomenia, but the species appropriate to the colder climate clearly dominate the flora.

These collections[1] are in no wise comprehensive enough to call for a review of the floras of the areas concerned, but they add very materially in new station records. They include several interesting types believed to be undescribed and, because of the importance of the older expeditions in other fields, have a considerable historical interest.

To all who have contributed specimens the writer expresses his indebtedness. In 1930 and in 1937 he had opportunity to examine pertinent material in England, Sweden, and Denmark through the great kindness of J. Ramsbottom, Esq., Keeper of Botany in the British Museum (Natural History), and of G. Tandy, Esq., Assistant Keeper; of Dr. A. D. Cotton, Director of the Herbarium, and of Miss C. Dickinson, assistant, both of the Royal Botanic Garden, Kew; of Professor Nils Svedelius of the Botanical Institute, Upsala; of Professor Harold Kylin of the Botanical Institute, Lund; of Professor Carl Skottsberg of the Botanical Institute, Göteborg; and of Dr. F. Børgesen of the Botanical Museum, Copenhagen. Dr. D. H. Linder of the Farlow Herbarium and Mr. W. E. Schevill of the Museum of Comparative Zoölogy, Cambridge, kindly supplied information on the itinerary of the "Hassler" expedition. To all these persons and institutions he must acknowledge generous help and the opportunity to study the specimens in their care. Professor H. H. Bartlett, of the University of Michigan, kindly assisted in preparing for publication the descriptions of new species.

[1] The material from the "Hassler," "Albatross," and Schmitt expeditions reached the writer either in fluid or unsorted on paper, without being provided with individual numbers. The present author, when mounting and arranging these collections, assigned serial numbers in each case, in order to provide for the identification of the duplicate material. These numbers should not be interpreted as indicating any original sequence of collection in the field or in the herbarium.

List of Species

MYXOPHYCEAE

OSCILLATORIACEAE

Lyngbya confervoides C. Agardh ex Gomont. — Uruguay: Isla de Lobos, on surf-beaten rocks, March 22, 1932 (Jordan E–b–1, det. F. Drouet).

References: Taylor 1928, p. 44, 1931, p. 286.

CHLOROPHYCEAE

ULVACEAE

Enteromorpha bulbosa (Suhr) Kützing. — Plants, incomplete, to about a decimeter tall, to 2–4 mm. diam., subsimple, tubular; when dry rather rigid, thick and dark, the whole membrane 28–42 μ; cells irregularly placed or occasionally oriented in vague longitudinal rows, rather angular, 7–22 μ diam., much deeper than broad; lateral walls rather thick, inner and outer walls thicker, to 2.5–3.0 μ.

Uruguay: Punta del Este, Nov. 15, 1925 (Schmitt 85), Puerto la Paloma, Dec. 6, 1925 (Schmitt 287). Chile: Isla Sta. Magdalena (Hassler 2055), Punta Arenas, Feb. 2, 1927 (Schmitt 269), Bahía Tandy (Hassler 2027, 2039).

References: Hariot 1888, p. 28 (as *Ulva bulbosa*); Reinsch 1890, p. 419 (as *E. novae-hollandiae*); Svedelius 1900, p. 288; Reinbold 1908, p. 185; Gain 1912, pp. 26, 117; Cotton 1915, p. 160; Hylmö 1919, p. 3.

Enteromorpha compressa (Linnaeus) Greville. — Plants to 2.5 dm. tall, tubular, sparingly branched near the base, simple above and widening to 4 mm. diam.; cells irregularly placed, rounded-angular, 8–13 μ diam., rather deeper than broad; cell walls rather thick, the inner and outer not notably thicker, the whole membrane about 28 μ.

Uruguay: Punta del Este, in rock pools, March 17, 1932 (Jordan B–a–1).

References: Hooker and Harvey 1847, p. 500 (? *p. p.*); Hariot 1888, p. 28 (as *Ulva Enteromorpha* v. *compressa*); Reinbold 1908,

p. 185; Gain 1912, p. 117; Cotton 1915, p. 160; Howe 1931, p. 605 (v. *constricta*); Taylor 1931, p. 287, 1937, p. 64.

ENTEROMORPHA ERECTA (Lyngbye) J. Agardh. — Plants somewhat gregarious, erect, to 8 cm. tall, to 0.5–1.0 mm. diam., with the main axis sparingly divided, these branches beset with numerous slender erect pluriseriate branchlets to 1–2 cm. long; cells in the wider parts in distinct longitudinal rows, rectangular, longer than broad, the width 13–19 μ.

Argentine Rep.: Puerto Antonio, Golfo de San Matias (Hassler 1118).

References: Taylor 1931, p. 287, 1937, p. 63.

This material does not seem to differ in any important particular from the plants of the Northern Hemisphere. The branchlets, when extremely small, were briefly uniseriate-tipped, but when mature they were about as broad as the axis all the way to the end.

ENTEROMORPHA INTESTINALIS (Linnaeus) Link. — Plants simple, erect, to 8 cm. tall, the upper part to 7 mm. diam., the lower part long-tapered to the holdfast; cells not arranged in any apparent order, rounded-angular, cell diameter 7.5–11.5 μ, depth 9.5–13.5 μ, exceeding the apparent width; the walls moderately thickened, the outer membrane not conspicuous.

Uruguay: Montevideo, Nov. 13, 1925 (Schmitt 90).

References: Gain 1912, p. 117; Taylor 1931, p. 287, 1937, p. 65.

The few pieces of the present species secured from among other material came rather as a surprise, for records of *E. intestinalis* from the tropics and the Southern Hemisphere are generally open to question.

ENTEROMORPHA LINZA (Linnaeus) J. Agardh *f.* — Plants gregarious, the blades with a short stalk and tapering base, to 15 cm. long, 1.5–2.5 cm. wide, the margin somewhat undulate and crisped; basal part and blade margins tubular, the flat part of the blade of two cell layers, forming a membrane whose thickness above is about 25 μ, the cells 7.5 μ deep, which is less than their apparent width, whereas below the thickness is 35–40 μ, the cells in section squarish, appearing a little deeper (10–12 μ) than broad; cells in surface view irregularly disposed or, often, in recognizable longitudinal rows, angular, often rectangular, 7.5–17.0 μ diam.

Chile: Isla Sta. Magdalena (Hassler 2068); Bahía Tandy (Hassler 2042).

References: Taylor 1931, p. 287, 1937, p. 65.

These specimens showed no important difference from northern representatives except a tendency for the linear orientation of the cells to extend farther up the blade than is usual in the north.

ENTEROMORPHA MICROCOCCA Kützing *f.* ? — Plants small, gregarious, attached, up to 1.5 cm. tall, the simple or subsimple tubular blades not much twisted, tapering gradually or abruptly into the slender stalk; cells in no definite order or below vaguely in longitudinal series, somewhat angular, rather longer than broad, 5.5–9.5 μ wide; lateral walls not very thick, but the inner and outer conspicuously thicker, especially the inner one, which reaches 3 μ, the whole membrane 18 22 μ thick.

Uruguay: Isla de Lobos, on a rock in the surf, March 22, 1932 (Jordan E–c–1).

Reference: Taylor 1937, p. 67.

ENTEROMORPHA RAMULOSA (J. E. Smith) Hooker f. — Plants to 2.5 dm. tall, tubular, slender, primary branches few and slender, seldom exceeding 1 mm. diam., the narrower secondary branches few to many; branchlets very numerous and small, generally spinuliform; cells angular, rather irregularly arranged below, but in definite rows in the smaller branches, 10 18 μ diam., lateral walls rather thick, inner and outer walls not conspicuously thicker, the whole membrane about 20 μ thick.

Chile: Bahía Borja (Hassler 48); Bahía Tandy (Hassler 2026); Puerto Mayne (Hassler 75); Caleta Latitud, Feb. 6, 1888 (Albatross 45).

References: Sowerby 1790 1814, pl. 2137, Kützing 1856, p. 12, pl. 33 II.

ULVA FASCIATA Delile. — Plants to 1.5 dm. tall, divided from near the base into several segments 1–3 cm. wide, with irregularly coarsely crenate-dentate margins; the cells rounded to slightly angular, 10–22 μ diam., columnar in section and 45–50 μ deep. the whole membrane to 122 μ thick.

Uruguay: Punta del Este, in rock pools, March 17, 1932 (Jordan B–d–1).

Reference: Taylor 1931, p. 288.

ULVA LACTUCA Linnaeus v. LATISSIMA (Linnaeus) De Candolle. — Falkland Islands: Port Stanley (Schmitt 99a), Feb. 22, 1927 (Schmitt 300), March 16, 1927 (Schmitt 231). Chile: Bahía

Laredo, Jan. 22, 1888 (Albatross 65), Caleta Latitud, Feb. 6, 1888 (Albatross 44), Puerto Otway, Feb. 6, 1888 (Albatross 9).

V. RIGIDA (C. Agardh) Le Jolis. — Falkland Islands: Port Stanley, March 16, 1927 (Schmitt 231). Chile: Bahía Tandy (Hassler 2013).

References: Hooker and Harvey 1847, p. 498; Hariot 1888, p. 26; Reinsch 1890, p. 56; Svedelius 1900, p. 284; Reinbold 1908, p. 185; Gain 1912, p. 117; Cotton 1915, p. 160; Hylmö 1919, p. 1; Taylor 1928, p. 57, 1931, p. 288, 1937, p. 75; Howe 1931, p. 605.

CLADOPHORACEAE

CLADOPHORA SP. — Plant bushy, bright green, harsh in texture, somewhat entangled below, to about 1 dm. tall; freely alternately radially branched, the form of the plant dominated by several main branches, the lateral divisions shorter; axes below 45–85 μ diam., the cells 6–9 diameters long, not contracted at the septa, above about 65 μ diam., the cells 3.5 diameters long; branchlets closely unilateral, sometimes groups alternating to one side or the other, rather long and slender, 40–45 μ diam., the cells 1.5–2.0 diameters long, the tip cell distally somewhat tapered with a rounded apex.

Chile: Bahía Tandy (Hassler 2020).

CLADOPHORA FALKLANDICA (Hooker f. & Harvey) Hooker f. & Harvey. — Plants about 2 dm. tall (incomplete), slightly twisted into strands, the main axes with relatively few primary branches, the secondary branches more numerous; the axis below about 65 μ diam., the cells 3.5–4.0 diameters long, the nodes not contracted; branchlets scattered, opposite, or alternate, somewhat erect, long, and slender, cells about 40 μ diam., 120–160 μ long.

Falkland Islands: Port Stanley, Feb. 22, 1927 (Schmitt 298). Chile: Caleta Latitud, Feb. 6, 1888 (Albatross 46).

References: Hooker and Harvey 1845, p. 294 (as *Conferva falklandica*), 1847, p. 495; Hariot 1888, p. 20; Gain 1912, p. 118; Cotton 1915, p. 162; Hylmö 1919, p. 9.

CLADOPHORA FASCICULARIS (Mertens) Kützing. — Uruguay: Puerto la Paloma, littoral, Dec. 6, 1925 (Schmitt 278, 289).

References: Taylor 1928, p. 62, 1931, p. 289.

CLADOPHORA UTRICULOSA Kützing. — Plants bushy, to 5 cm. tall,

rather stiff; branching alternate, the main filaments to 325 μ or more in diam. below, cells 3–5 diameters long, the lesser branches spreading or somewhat recurved, often arising at a node with 1–2 branchlets; the upper branchlets 1–2 (5) at a node, tending to be unilateral on the upper side of the branch, 60–85 μ diam., the cells 3–5 diameters long, the terminal cell blunt.

Uruguay: La Paloma, Nov. 7, 1934 (Herter 95056); Punta del Este, in rock pools, March 17, 1932 (Jordan B–c–1).

Reference: Kützing 1853, pl. 94 I.

SPONGOMORPHA ARCTA (Dillwyn) Kützing. — Plants forming dense dark green tufts, brighter above, to about 6 cm. tall, the filaments erect, below considerably united by rhizoidal branchlets; apical cells about 65 μ diam., 9–10 diameters long.

Chile: Bahía Sholl (Hassler 41). Apical cells rather longer than usual, but the plant apparently in a rapidly growing state, which may account for this.

References: Hooker and Harvey 1847, p. 495; Hariot 1888, p. 21; Reinsch 1890, p. 424; Reinbold 1908, p. 186 (all, probably *p. p.*, as *Cladophora arcta*); Gain 1912, pp. 31, 118 (as *Acrosiphonia arcta*); Cotton 1915, p. 163 (as *C. arcta*); Taylor 1937, p. 43.

SPONGOMORPHA OXYCLADA (Montagne) Kützing. — Plants tufted, to 9 cm. tall, below entangled into ropelike strands united by very numerous rhizoids, above spreading and bushy; diameter of axes below 75–90 μ, cells 3–4 diameters long, walls rather firm and thick; rhizoids 40 μ diam., with cells 6–10 diameters long; branching irregularly alternate below, more or less dichotomous above, all branches and branchlets erect-appressed, the upper clustered; branchlets 50–60 μ diam., the cells 1.7–2.5 diameters long except the terminal ones, which are small and sharply pointed.

Chile: Caleta Latitud, Feb. 6, 1888 (Albatross 12, 47, 48).

References: Kützing 1854, pl. 79 II e–h; Hariot 1888, p. 22 (as *Cladophora oxyclada*).

SPONGOMORPHA SPINESCENS Kützing. — Plant tufted, rather spongy, the lower branches united in dense ropelike masses by rhizoidal and numerous hooked, spinelike branchlets; upper branchlets about 75 μ diam., the tip cells swollen to 95 μ, and about 3 diameters long.

Chile: Bahía Sholl (Hassler 38, 40).

Reference: Taylor 1937, p. 94.

BRYOPSIDACEAE

BRYOPSIS AUSTRALIS Sonder. — Plants to 10–12 cm. tall, dark green, the axes sparingly branched and heavily rhizoid-invested below; above bearing successively shorter lateral branches to form rather dense lanceolate tufts; branchlets closely radially inserted, 160–220 μ diam., tapering toward the tip.

Falkland Islands: Port Stanley (Schmitt 103), Feb. 22, 1927 (Schmitt 302a), March 16, 1927 (Schmitt 217).

Reference: Hylmö 1919, p. 15.

BRYOPSIS PLUMOSA (Hudson) G. Agardh. — Uruguay: among submerged rocks, Punta del Este, April, 1925 (Herter 77900).

References: Gain 1912, p. 118; Taylor 1928, p. 93, 1931, p. 290, 1937, p. 98; Howe 1931, p. 606.

BRYOPSIS ROSAE Gaudichaud. — Plants to 15–17 cm. tall, dull green, freely branched below, not invested by rhizoids, the fairly coarse axes about 600 μ diam., with walls to 35 μ thick; above bearing numerous shorter lateral branches so as to form rather loose though large clusters; branchlets bilaterally placed, 240–275 μ diam., 3–7 mm. long, very sharply contracted at the base, bluntly tapered at the tips.

Chile: Isla Sta. Magdalena (Hassler 2054); Bahía Tandy (Hassler 2012).

References: Hooker and Harvey 1847, p. 492; Hariot 1888, p. 32; Gain 1912, p. 118; Hylmö 1919, p. 14.

CODIACEAE

CODIUM DIFFORME Kützing. — Falkland Islands: Port Stanley, dredged among kelp above the Battle Monument, Feb. 23, 1937 (Schmitt 285); Port Stanley, March 16, 1927 (Schmitt 225); Whale Sound, Port Stanley, dredged in 4–5 meters, April 26, 1927 (Schmitt S-118).

References: Hariot 1888, p. 32; Reinbold 1908, p. 187; Gain 1912, p. 118; Cotton 1915, p. 164; Hylmö 1919, p. 12; Schmidt 1923, p. 31.

CODIUM FRAGILE (Suringar) Hariot. — Falkland Islands: Port Stanley, Feb. 22, 1927, with sporangia (Schmitt 297, 115). Chile: Magellan Strait (Hassler 2083).

References: Hooker and Harvey 1847, p. 491 (as *C. tomentosum*); Hariot 1888, p. 32; Svedelius 1900, p. 299 (as *C. mucronatum* v. *californicum*); Gain 1912, p. 118; Cotton 1915, p. 165; Hylmö 1919, p. 14 (both as *C. mucronatum*); Schmidt 1923, p. 47.

PHAEOPHYCEAE

ECTOCARPACEAE

Ectocarpus confervoides (Roth) Le Jolis. — Argentine Rep.: probably Cabo Buen Tiempo, March 12, 1872, with plurilocular gametangia (Hassler 25). Chile: Bahía Sholl, with gametangia (Hassler 36); Caleta Latitud, with gametangia, Feb. 6, 1888 (Albatross 49).

References: Hariot 1888, p. 35; Gain 1912, p. 119; Taylor 1928, p. 107, 1931, p. 293, 1937, p. 109.

Ectocarpus Constanciae Hariot. — Plants epiphytic, to 3 cm. tall, color dull brownish, texture rather firm; the main filaments erect, somewhat twisted together, the strands invested by numerous spreading branchlets; the lateral branches and branchlets relatively short, alternate, divergent; axial filaments 28-40 μ diam., the cells 65-110 μ long; lesser branches above 15-20 μ diam., the cells 19-28 μ long; plurilocular gametangia numerous, scattered, terminal on branchlets, pedicellate or sessile, especially above, strongly divergent, or when sessile more erect, in shape obtuse, conical to lanceolate or long-ovate, 45-55 μ diam., 20-28 μ long.

Falkland Islands: Port Stanley, on coarse algae, with plurilocular gametangia, April 14, 1927 (Schmitt 306).

References: Hariot 1888, p. 36; Skottsberg 1907, p. 7, 1921, p. 7; Cotton 1915, p. 174.

Ectocarpus siliculosus (Linnaeus) Kjellman. — Chile: Isla Sta. Magdalena, plurilocular gametangia (Hassler).

References: Hariot 1888, p. 36; Gain 1912, p. 119; Taylor 1937, p. 108.

Pylaiella litoralis (Linnaeus) Kjellman. — Chile: Bahía Sholl, with unilocular sporangia (Hassler 32, 44); Caleta Latitud, Feb. 6, 1888, with plurilocular gametangia (Albatross 50).

References: Gain 1912, p. 119; Cotton 1915, p. 174; Taylor 1931, p. 294, 1937, p. 103.

SPHACELARIACEAE

CLADOSTEPHUS ANTARCTICUS Kützing. — Argentine Rep.: probably Cabo Buen Tiempo, plurilocular gametangia abundant, March 12, 1872 (Hassler 27).

References: Hariot 1888, p. 40; Gain 1912, p. 119; Skottsberg 1921, p. 44.

Skottsberg (*loc. cit.*) indicates that distinctions between *C. antarcticus* and *C. setaceus* (the earlier-described species) are not well defined, the former showing frequent forked branchlets, which are markedly characteristic of the present material.

CLADOSTEPHUS SETACEUS Suhr. — Falkland Islands: Port Stanley, unilocular sporangia abundant (Schmitt 101), March 16, 1927 (Schmitt 218). Chile: Bahía Tandy, with sporangia (Hassler 2017).

References: Skottsberg 1907, p. 58, 1921, p. 119; Cotton 1915, p. 173.

In this material forked branchlets were practically absent, agreeing with Skottsberg's account (*loc. cit.*).

DICTYOTACEAE

DICTYOTA CERVICORNIS Kutzing. — Argentine Rep.: Puerto Antonio, Golfo de San Matias (Hassler 1106, 1108, 1109, 1110), probably Cabo Buen Tiempo, March 12, 1872 (Hassler 26).

References: Taylor 1928, p. 118, 1931, p. 295.

DICTYOTA DIVARICATA Lamouroux. — Argentine Rep.: Puerto Antonio, Golfo de San Matias (Hassler 1107).

References: Taylor 1928, p. 120, 1931, p. 295.

CHORDARIACEAE

AEGIRA VIRESCENS (Carmichael) Setchell & Gardner. — Plant small, incomplete, the axis to 4 mm. diam., the several branches to 5.5 cm. long, 2.5 mm. diam., smooth and straight; assimilators rather slender, the outer cells oval, nearly symmetrical, not markedly larger than the lower ones, 9.5–11.5 μ diam.; unilocular sporangia elliptical to oval, 55–85 μ diam., 103–130 μ long.

Chile: Punta Arenas, with unilocular sporangia, Feb. 2, 1927 (Schmitt 268).

Reference: Taylor 1937, p. 140.

In general aspect quite like the plant which goes under this name in New England, the Chilean specimen differs only in having more slender assimilators and rather larger sporangia.

CHORDARIA FLAGELLIFORMIS (Müller) C. Agardh. — Plants to 2.0–2.5 dm. tall, dark blackish brown, the main axis erect and persistent, bearing many radially placed lateral branches, which are simple or occasionally bear branchlets of 1–2 degrees, the upper branches mostly longer than the lower ones; diameter of axis and branches about 1 mm., their structure firm, solid in section, the medulla consisting of large and small cells intermixed, bearing a superficial layer of assimilators which are 5–6 cells or 90 μ long, the end cell being 9–14 μ diam., and the lower cells gradually more slender and longer to the base; unilocular sporangia oval or obovate, 25–28 μ diam., 77–90 μ long, blunt, with the end wall little thickened.

Chile: Isla Sta. Magdalena (Hassler 2070), Bahía Borja (Hassler 45), Bahía Tandy, with unilocular sporangia (Hassler 2015).

References: Hariot 1888, p. 40; Skottsberg 1907, pp. 56, 57, 1921, p. 26; Gain 1912, p. 120; Taylor 1937, p. 143.

DESMARESTIACEAE

DESMARESTIA LIGULATA (Lightfoot) Lamouroux. — Falkland Islands: Port Stanley (Schmitt 120). Chile: Isla Sta. Magdalena (Hassler 2073); Bahía Laredo, Jan. 22, 1888 (Albatross 67); Punta Arenas, juvenile, Feb. 4, 1927 (Schmitt 320a); Bahía Tandy (Hassler 2018, 2041).

References: Hooker and Harvey 1847, p. 467; Reinsch 1890, p. 411; Skottsberg 1907, p. 21 (as *D. firma*), 1921, p. 21; Gain 1912, p. 19; Cotton 1915, p. 171.

DESMARESTIA ROSSII Hooker f. & Harvey. — Falkland Islands: Port Stanley (Schmitt 125).

References: Hooker and Harvey 1845, p. 249, 1847, p. 467; Ardissone 1888, p. 211; Hariot 1888, p. 42; Reinsch 1890, p. 409; Skottsberg 1907, p. 20, 1921, p. 21; Gain 1912, p. 119; Gepp and Gepp 1912, p. 77; Cotton 1915, p. 171; De Wildeman 1935, p. 45.

DESMARESTIA WILLEI Reinsch. — Falkland Islands: Port Stanley

(Schmitt 111), March 16, 1927 (Schmitt 230), dredged at 4–5 meters in Whale Sound between the wireless pier and the Narrows, April 16, 1927 (Schmitt 286). Chile: Punta Arenas, Feb. 4, 1927 (Schmitt 320).

References: Hooker and Harvey 1847, p. 466; Hariot 1888, p. 42 (both as *D. viridis*); Reinsch 1890, p. 410; Skottsberg 1907, p. 16, 1921, p. 20; Reinbold 1908, p. 191; Gain 1912, pp. 36, 119; Cotton 1915, p. 170.

ASPEROCOCCACEAE

COLPOMENIA SINUOSA (Roth) Derbès & Solier. — Argentine Rep.: Puerto Antonio, Golfo de San Matias (Hassler).

References: Taylor 1928, p. 110, 1931, p. 294.

SCYTOSIPHON LOMENTARIA (Lyngbye) J. Agardh. — Chile: Bahía Sholl (Hassler 33).

References: Hooker and Harvey 1847, p. 468 (as *Chorda lomentaria*); Hariot 1888, p. 45 (as *S. lomentarium*); Skottsberg 1907, p. 34 (as *S. lomentarius*), 1921, p. 36; Gain 1912, p. 119; Cotton 1915, p. 172 (as *S. lomentarius*); Taylor 1937, p. 174.

DICTYOSIPHONACEAE

SCYTOTHAMNUS FASCICULATUS (Hooker f. & Harvey) Cotton. — Chile: Bahía Borja (Hassler 49), Bahía Sholl, with unilocular sporangia (Hassler 31, 39).

References: Hooker and Harvey 1845, p. 250, 1847, p. 467; Hariot 1888, p. 44 (all as *Dictysiphon fasciculatus*); Skottsberg 1907, p. 48 (as *Scytothamnus australis*), 1921, p. 34; Reinbold 1908, p. 192 (as *Dictysiphon fasciculatus*); Cotton 1915, p. 170.

LAMINARIACEAE

ADENOCYSTIS UTRICULARIS (Bory) Skottsberg. — Plants to 7.5 cm. tall, the utricles tapered below, broader above, reaching 2.7 cm. diam.

Argentine Rep.: probably Cabo Buen Tiempo, March 12, 1872 (Hassler 28). Falkland Islands: Port Stanley, March 16, 1927 (Schmitt 227). Chile: Punta Arenas, Feb. 2, 1927 (Schmitt 265); Bahía Tandy (Hassler 2010).

References: Bory de St. Vincent 1828, p. 199 (as *Asperococcus*

Lessonii); Hooker and Harvey 1845, p. 251, 1847, p. 468; Hariot 1888, p. 47 (both as *Adenocystis Lessonii*); Reinsch 1890, p. 403, pl. 8, figs. 1, 5 (as *Chroa sacculiformis*); Skottsberg 1907, p. 39, 1921, p. 39; Reinbold 1908, p. 190; Gain 1912, pp. 43, 120; Gepp and Gepp 1912, p. 77 (both as *Ad. Lessonii*); Cotton 1915, p. 166; De Wildeman 1935, p. 44 (as *Ad. Lessonii*).

ADENOCYSTIS UTRICULARIS f. LONGISSIMA Skottsberg. — Utricles to 8 cm. long, 6 mm. diam., subcylindrical, rounded above and long-tapering below.

Chile: Bahía Tandy (Hassler 2011); Caleta Latitud, Feb. 6, 1888 (Albatross 43).

Reference: Skottsberg 1921, p. 38.

LESSONIA FLAVICANS Bory. — Stipe to 21 cm. long below the first fork, individual serrate blades to 40 cm. long, 9 cm. wide, the specimens young.

Falkland Islands: Port Stanley (Schmitt 121). Chile: Punta Arenas, Feb. 4, 1927 (Schmitt 321).

References: Hooker and Harvey 1847, p. 457 (as *L. fuscescens*), p. 459 (as *L. ovata*); Hariot 1888, p. 49; Skottsberg 1907, p. 73, 1921, p. 47; Gain 1912, p. 120; Cotton 1915, p. 167.

LESSONIA FRUTESCENS Skottsberg. — Stalk about 2 cm. long below the first fork, arising from a rather large fibrous holdfast; blades to 5.5. dm. long by 7.5 cm. wide, with entire margins.

Falkland Islands: Port Stanley (Schmitt 118).

References: Skottsberg 1907, p. 78, 1921, p. 48; Gain 1912, p. 120; Cotton 1915, p. 167.

LESSONIA NIGRESCENS Bory. — Stipe long and heavy, dividing several times below the leaves into strong subdivisions, the leaf blades to 4.8 dm. long, 2.5 cm. wide, with entire margins.

Falkland Islands: Port Stanley (Schmitt 122).

References: Hooker and Harvey 1847, p. 458; Hariot 1888, p. 49; Skottsberg 1907, p. 69, 1921, p. 47; Gain 1912, p. 120; Cotton 1915, p. 166.

MACROCYSTIS PYRIFERA (Linnaeus) C. Agardh. — Uruguay: on submerged rocks, La Paloma (Herter 95005). Falkland Islands: Port Stanley (Schmitt 100), March 16, 1927 (Schmitt 220). Chile: Magellan Strait (Hassler 2085); Punta Arenas, Feb. 2, 1927 (Schmitt 273); Bahía Glacier (Hassler 103); Puerto Bueno (Hassler 101).

References: Hooker and Harvey 1847, p. 461; Hariot 1888, p. 50; Skottsberg 1907, p. 80, 1921, p. 49; Gain 1912, p. 120; Cotton 1915, p. 167.

FUCACEAE

DURVILLEA ANTARCTICA (Chamisso) Hariot. — Fragments; a disciform holdfast guided the determination. It is unfortunate that this, one of the largest algae of far southern waters, should be represented in these collections by such paltry material.

Chile: Magellan Strait (Hassler 2084, 2086); Bahía Sholl (Hassler 2081).

References: Hooker and Harvey 1847, p. 454; Hariot 1888, p. 53 (both as *D. utilis*); Skottsberg 1907, p. 140, 1921, p. 54; Reinbold 1908, p. 189 (as *D. utilis*); Gain 1912, pp. 51, 120; Cotton 1915, p. 165.

RHODOPHYCEAE

BANGIACEAE

BANGIA FUSCOPURPUREA (Dillwyn) Lyngbye. — Uruguay: La Paloma, submerged, Nov. 7, 1934 (Herter 95008).

Reference: Taylor 1937, p. 218.

GONIOTRICHUM ALSIDII (Zanardini) Howe. — Uruguay: Punta del Este, on Polysiphonia, March 17, 1932 (Jordan B b 1).

Reference: Taylor 1937, p. 215.

PORPHYRA UMBILICALIS (Linnaeus) J. Agardh. — Plants about 2 dm. diam., pseudoumbilicate, undulate, marginally laciniate, rather nitent; cells in surface view rather rounded (? shrunken) between moderately thick walls, 9-15 μ diam.; the whole membrane 45-60 μ thick, with one layer of cells of columnar aspect and about 27 μ deep.

Chile: Isla Sta. Magdalena (Hassler 2053), Bahía Tandy (Hassler 2016).

References: Hooker and Harvey 1847, p. 500; Hariot 1888, p. 54; Reinsch 1890, p. 396; Reinbold 1908, p. 192; Gain 1912, p. 120 (all as *P. laciniata*); Gepp and Gepp 1912, p. 77 (as *Wildemania laciniata*); Cotton 1915, p. 175; Kylin and Skottsberg 1919, p. 3 (in part as *P. laciniata*); Skottsberg 1923, p. 4; De Wildeman 1935, p. 38 (as *W. laciniata*); Taylor 1937, p. 221.

BONNEMAISONIACEAE

PTILONIA MAGELLANICA (Montagne) J. Agardh. — Falkland Islands: Port Stanley, March 16, 1927, carposporic (Schmitt 226).

References: Montagne 1842, p. 3 (as *Thamnophora magellanica*); Hooker and Harvey 1847, p. 474 (as *Plocamium? magellanicum*); Ardissone 1888, p. 215 (as *T. magellanica*); Reinbold 1908, p. 197; Gain 1912, p. 122; Cotton 1915, p. 186; Kylin and Skottsberg 1919, p. 51; Skottsberg 1923, p. 53.

HELMINTHOCLADIACEAE

NEMALION HELMINTHOIDEA (Velley) Batters? — Plant to 2.2 dm. tall, with several subsimple axes coming from a common (or fused) holdfast; these axes very soft, vermiform to straight, to 4 mm. diam.; medullary filaments twisted near the center into a definite strand; assimilatory filaments 3–4 times dichotomous, the inner cells subcylindrical, the outer truncate-ovoid, 7–8 μ diam., 11–14 μ long; cystocarps among the assimilators, 40–80 μ diam.

Uruguay: Puerto la Paloma, littoral, cystocarpic, Dec. 6, 1925 (Schmitt 293, det. M. A. Howe).

CHAETANGIACEAE

CHAETANGIUM FASTIGIATUM (Bory) J. Agardh. — Argentine Rep.: "Golfo de San Matias [probably Cabo Buen Tiempo], 12 Mar. 1872" (Hassler). Chile: Bahía Borja (Hassler 51), Bahía Sholl (Hassler 37).

References: Hooker and Harvey 1847, p. 487 (as *Nothogenia variolosa p. p.*); Reinbold 1908, p. 192; Gain 1912, p. 121 (as *C. variolosum p. p.?*); Cotton 1915, p. 175; Kylin and Skottsberg 1919, p. 6; Skottsberg 1923, p. 5.

GELIDIACEAE

GELIDIUM CORNEUM (Hudson) Lamouroux. — Uruguay: Puerto la Paloma littoral, Dec. 6, 1925 (Schmitt 292), Isla de Lobos, drifted ashore March 22, 1932 (Jordan E-d-1), Punta del Este, on rocks, Nov. 15, 1925 (Schmitt 78, 80), March 16, 1932 (Jordan A-a-3).

References: Taylor 1928, p. 142, 1931, p. 300; Howe 1931, p. 607.

SQUAMARIACEAE

HILDEBRANDIA LECANNELIERI Hariot. — Crustose, about 5 mm. thick, dull reddish brown, nodulose, clathrate, with tetrasporangia in crypts.

Chile: Bahía Borja (Hassler 50).

References: Hariot 1888, p. 81; Gain 1912, p. 125; Cotton 1915, p. 192; Kylin and Skottsberg 1919, p. 75; Skottsberg 1923, p. 63.

CORALLINACEAE

EPILITHON VALLENTINAE Lemoine. — Falkland Islands: Port Stanley, on Epymenia (Schmitt 105, det. M. A. Howe).

Reference: Lemoine in Cotton 1915, p. 198.

LITHOTHAMNION FUEGIANUM Foslie? — Falkland Islands: Port Stanley, March 16, 1927 (Schmitt 92).

References: Foslie 1907, p. 5, 1929, pl. 6, figs. 12–15; Lemoine 1913, p. 29, in Cotton 1915, p. 198.

LITHOTHAMNION NEGLECTUM Foslie. — Falkland Islands: April 24, 1927 (Schmitt 117).

References: Lemoine 1913, p. 14, in Cotton 1915, p. 196; Foslie 1929, pl. 9, fig. 4.

AMPHIROA BEAUVOISII Lamouroux. — Uruguay: Isla de Lobos, drifted ashore March 22, 1932 (Jordan E–a–1).

Reference: Taylor 1931, p. 309.

CORALLINA OFFICINALIS Linnaeus. — Uruguay: Puerto la Paloma, Dec. 6, 1925 (Schmitt S–75). Argentine Rep.: off Cabo Dos Bahías, from floating Macrocystis, March 9, 1872 (Hassler 23), "San Matias Bay [probably Cabo Buen Tiempo], 12 Mar. 1872" (Hassler). Chile: Isla Sta. Magdalena (Hassler 2056).

References: Hariot 1888, p. 87; Gain 1912, p. 125; Cotton 1915, p. 192; Skottsberg 1923, p. 67; Howe 1931, p. 610; Taylor 1937, p. 271.

JANIA RUBENS (Linnaeus) Lamouroux. — Uruguay: Punta del Este, among rocks, April, 1929 (Herter 1269).

References: Taylor 1928, p. 206, 1931, p. 311.

CALLYMENIACEAE

CALLOPHYLLIS ATROSANGUINEA (Hooker f. & Harvey) Hariot. — Chile: Isla Sta. Magdalena (Hassler 2057), Bahía Tandy (Hassler 2044).

References: Hooker and Harvey 1845, p. 258 (as *Rhodomenia Hookeri* v. *atrosanguinea*), 1847, p. 476 (as *Rhodymenia variegata* v. *atrosanguinea*); Hariot 1888, p. 75; Gain 1912, p. 121; Cotton 1915, p. 178; Kylin and Skottsberg 1919, p. 13; Skottsberg 1923, p. 12; probably different from *C. microdonta, contra* Howe and Taylor 1931, p. 11.

CALLOPHYLLIS MULTIFIDA (Reinsch) Kylin. — Chile: Bahía Tandy (Hassler 2008).

References: Reinsch 1890, p. 393 (as *Kallymenia multifida*); Kylin in Kylin and Skottsberg 1919, p. 13; Skottsberg 1923, p. 12.

CALLOPHYLLIS VARIEGATA (Bory) Kützing. — Falkland Islands: Port Stanley (Schmitt 114), March 16, 1927 (Schmitt 216), Feb. 22, 1927 (Schmitt 296). Chile: Isla Sta. Magdalena (Hassler 2071), Bahía Tandy (Hassler 2009).

References: Hooker and Harvey 1847, p. 475 (as *Rhodymenia variegata*); Ardissone 1888, p. 214; Hariot 1888, p. 74; Reinbold 1908, p. 193; Gain 1912, p. 121; Gepp and Gepp 1912, p. 78; Cotton 1915, p. 178; Kylin and Skottsberg 1919, p. 13; Skottsberg 1923, p. 12.

PLOCAMIACEAE

PLOCAMIUM SECUNDATUM Kützing. — Falkland Islands: Port Stanley (Schmitt 102), tetrasporic, March 20, 1927 (Schmitt 254), Port William, dredged in 26–28 meters, April 7, 1927 (Schmitt 248). Chile: Bahía de Posesión, carpo- and tetrasporic, Jan. 18, 1888 (Albatross 33), Punta Arenas (Hassler 2003), Bahía Tandy (Hassler 2023).

References: Hariot 1888, p. 79; Gain 1912, p. 122; Cotton 1915, p. 181; Kylin and Skottsberg 1919, p. 31; Skottsberg 1923, p. 20.

RHODOPHYLLIDACEAE

ACANTHOCOCCUS ANTARCTICUS Hooker f. & Harvey. — Chile: Isla Sta. Magdalena (Hassler 2069), Punta Arenas (Hassler 2002),

Bahía Laredo, Jan. 22, 1888 (Albatross 56); Punta Famine (Hassler 2005), Bahía Tandy (Hassler 2040).

References: Hooker and Harvey 1845, p. 261, 1847, p. 477; Hariot 1888, p. 79; Reinbold 1908, p. 193; Gain 1912, p. 121; Cotton 1915, p. 179; Kylin and Skottsberg 1919, p. 16; Skottsberg 1923, p. 14.

HYPNEACEAE

HYPNEA MUSCIFORMIS (Wulfen) Lamouroux. — Uruguay: Punta del Este, on a wave-beaten rock, March 16, 1932 (Jordan A-c-1).

References: Taylor 1928, p. 156, 1931, p. 303, 1937, p. 291; Howe 1931, p. 608.

PHYLLOPHORACEAE

AHNFELTIA PLICATA (Hudson) Fries. — Falkland Islands: Port Stanley (Schmitt 109), March 20, 1927 (Schmitt 253).

References: Hariot 1888, p. 71; Gain 1912, p. 121; Cotton 1915, p. 178; Skottsberg 1923, p. 10; Taylor 1937, p. 295.

GIGARTINACEAE

GIGARTINA ELEGANS Greville. — Uruguay: La Paloma, Nov. 7, 1934 (Herter 95009)

References: Howe 1931, p. 607; Taylor 1931, p. 301; Setchell and Gardner 1933, p. 294.

GIGARTINA PAPILLOSA (Bory) Setchell & Gardner. — Falkland Islands: Port Stanley (Schmitt 113), Feb. 22, 1927 (Schmitt 302, det. W. A. Setchell).

Reference: Setchell and Gardner 1937, p. 233.

GIGARTINA SKOTTSBERGII Setchell & Gardner. — Falkland Islands: Port Stanley (Schmitt 113, designated by the authors as the tetrasporic TYPE of the species). Chile: Isla Sta. Magdalena (Hassler 2062), Puerto Bueno, carposporic (Hassler 102).

References: Setchell and Gardner 1936, p. 472, 1937, p. 224.

GIGARTINA TEEDII (Roth) Lamouroux. — Uruguay: Punta del Este, on a wave-beaten rock, March 16, 1932 (Jordan A-b-1).

References: Howe 1931, p. 607; Taylor 1931, p. 23; Setchell 1933, p. 294.

IRIDOPHYCUS CAESPITIPES Setchell & Gardner. — Chile: Isla Sta. Magdalena (Hassler 2066, marked by the authors as the TYPE of the species).

Reference: Setchell and Gardner 1937, p. 211.

IRIDOPHYCUS UNDULOSUM (Bory) Setchell & Gardner. — Falkland Islands: Port Stanley (Schmitt 123). Chile: Isla Sta. Magdalena (Hassler 2063, 2064, 2065), Bahía Laredo, Jan. 22, 1888 (Albatross 51), Bahía Tandy (Hassler 2046, 2048).

Reference: Setchell and Gardner 1937, p. 219.

RHODOGLOSSUM MACRODONTUM (Skottsberg) Setchell & Gardner. — Chile: Isla Sta. Magdalena (Hassler 2067, det. W. A. Setchell).

References: Skottsberg 1923, p. 8 (as *Iridaea macrodonta*); Setchell and Gardner 1937, p. 225.

RHODYMENIACEAE

Epymenia falklandica, sp. nov. — Plant to more than 2.5 dm. tall, the base disclike, the erect blades with a very short cylindrical stipe, above which they lack perceptible midribs, are about 1 cm. wide in the lower portion, somewhat broader farther up, the segments tapering downward to the forks, where they reach 1.5 cm.; branching below irregularly dichotomous, above becoming alternate; branch tips broadly rounded, becoming retuse as division approaches, but not spatulate; thickness of blade above about 175 μ, the medulla 110 μ thick, of 2–4 layers of large colorless cells with walls 3.5–5.5 μ thick, the cortex of about 2 layers of cells, those at the surface 3.5–5.5 μ diam. with the walls 2.5–3.5 μ thick; thallus near the base at the margins 275–300 μ thick, medulla 200 μ thick, of 3–5 layers of large colorless thick-walled (7.5–9.5 μ) cells with a cortex of 2–3 layers of pigmented cells of decreasing size, those at the surface rounded, not deeper than wide, 4.0–5.5 μ diam. with walls 2.0–3.5 μ thick; thallus near the base in its central part reaching 460 μ thick, increased by proliferation of the surface cells to form tiers 5–8 cells deep on one side of the thallus; tetrasporangia formed in small ovate to reniform slenderly stipitate chiefly marginal folioles, which are 2–4 mm. diam. at maturity, with a narrow sterile border, but a broad central area 210–250 μ thick, of which 135–170 μ is medulla; the oval tetrapartite sporangia 35–45 μ deep, 24–28 μ diam., crowded

with sterile filaments of 1–2 long cells to form a fruiting layer on each face. Pl. I.

Falkland Islands: Port Stanley, dredged in 15–19 meters, tetrasporic, March 20, 1927 (Schmitt 255, 256 TYPE). Chile: Bahía de Posesión, tetrasporic, Jan. 18, 1888 (Albatross 35).

Planta ex basi disciformi oriens, breviter stipitata, deorsum in segmenta liguliformia plerumque dichotoma divisa, sursum alternis haud dichotomis; apicibus ramulorum obtusis vel retusis, nec spatulatis; tetrasporangiis in foliolis minutis stipitatis ovatis vel reniformibus ad ramorum margines. Tab. I.

Insulae Falklandiae, in loco dicto Port Stanley, legit Waldo L. Schmitt.

Rhodymenia cuneifolia (Hooker f. & Harvey), comb. nov. — Plants with cylindrical stipes and flat blades, these dichotomously to irregularly divided, to 168–210 μ thick measured well beyond the thickened stipe, the segments triangular to ligulate, generally cuneate, proliferating from the distal margins, and occasionally branching from the faces of the blades; structurally parenchymatous in transverse section, the medulla of 1–3 layers of large cells within, 2–3 layers of smaller cells without, covered by cortical layers of small cells which are 5.5–8.5 μ wide, 7.5–9.5 μ long, all cell walls being thick.

Falkland Islands: Port Stanley (Schmitt 98). Chile: Punta Arenas, Feb. 4, 1927 (Schmitt 315), Puerto Bueno (Hassler 74).

References: Hooker and Harvey 1845, p. 260, 1847, p. 486; Hariot 1888, p. 72; Gain 1912, p. 121; Cotton 1915, p. 177 (all as *Phyllophora cuneifolia*); presumably Kylin and Skottsberg 1919, p. 19; Skottsberg 1923, p. 18 (both as *Rhodymenia Corallina*); certainly not Kylin 1931, p. 21, pl. 8 (cotype of *Sphaerococcus Corallinus*).

It is perfectly clear that the writer's material is the same plant as that found by Hooker, Vallentin, and others, and it is equally certain that the plant is not the one figured by Kylin (*loc. cit.*) in 1931. One may assume that Kylin withdraws from the position he took in 1919, which was that of Skottsberg (*loc. cit.*), reducing Hooker's plant to synonymy. Kylin and Skottsberg were probably right, however, in assigning the plants to Rhodymenia; the structure certainly is far from that of Phyllophora, and in the absence of fruit the writer has nothing better to suggest. It

seems necessary to make the new combination and to use Hooker and Harvey's name, since their plant was not dealt with in Kylin's later papers on Gigartinaceae and Rhodymeniaceae.

Rhodymenia Schmittii, sp. nov. — Plants to 17 cm. tall (incomplete) and 2 dm. broad, forming a wide flat divided blade with a cuneate base, which is narrow and subcylindrical near the holdfast, above flattened and expanding to 2–3 cm. in width before dividing, the first dichotomies close, producing a pseudopalmate appearance, the initial segments irregularly 4–6 times dichotomous, the overlapping, spreading branches arising at narrow to wide angles, the segments in the middle portions of the blade 5–7 mm. wide, little tapered between the forkings, which are 0.75–2.0 cm. apart, but somewhat broader in the ultimate segments, reaching as much as 10–12 mm. before dividing, the tips broadly rounded, becoming truncate and then emarginate as forking begins; thickness in the lower segments to 330 μ, the medulla of 2–3 layers of large colorless cells, being 85–95 μ thick, the cell walls 5.5–8.5 μ, the cortex of 2–3 layers of pigmented cells of decreasing size, the surface cells generally deeper than wide, 4.5–7.5 μ diam., with walls 1.5–2.5 μ thick; near the base the cortex is generally thickened on one or both sides by division of the surface cells to form irregular rows, so that the cortex may be as much as 170 μ thick with a cuticle of 18 μ; thickness in the upper part of the branches 95–105 μ, the medulla about 70 μ, of 2–3 layers of cells with walls 0.9 μ thick, the 1–2-layered cortex of rounded cells, which are about as deep as wide, 4.5–5.5 μ diam., with walls 2.0–3.0 μ thick; tetrasporangial sori transversely oval, terminal in rather narrow branches, to 4–5 mm. wide (young?), the branch very slightly contracted behind the sorus, which is up to 105 μ thick, a medulla 19–22 μ thick of 3–4 layers of flattened (inadequately restored?) cells supporting a fertile cortex on each side, this showing vertical cell rows about 5.5 μ diam., 2–3 cells long, the cells round to elongate with thick soft walls; oval tetrasporangia between the rows, tetrapartite, about 20–25 μ diam., 38–45 μ long. Pl. II, Fig. 2.

Falkland Islands: Port Stanley (Schmitt 119, TYPE).

Planta ex laminis dense divisis basi cuneata constans, infra ramos 2–3 cm. lata, superiore parte dense 4- vel 6-plo asymmetrice dichotomeque ramosa, segmentis irregulariter imbricatis; apicibus

ramorum rotundatis vel truncatis; tetrasporangiis in soris terminalibus transverse ovalibus in ramis angustiusculis posita. Tab. 2, Fig. 2.

Insulae Falklandiae, in loco dicto Port Stanley, legit Waldo L. Schmitt.

This proposed new species of Rhodymenia is most similar to *R. foliifera* Harvey, but, to judge by a photograph of authentic material (Kylin 1931, pl. 7, fig. 17), it is notably different in the much more broadly expanded central part and closer, broader upper divisions; the same features will distinguish it from *R. Corallina*. The first tips to become fertile seem generally to be those at the lower lateral borders of the blade.

CERAMIACEAE

ANTITHAMNION FLACCIDUM (Hooker f. & Harvey) De Toni. — Plants erect, to 7.5 cm. tall, dull red, loosely bushy, rather coarsely and evenly 3–4 times branched, the chief branches long and spreading; axes below sometimes held together with hooked branchlets and also bearing a few attaching rhizoids about 40 μ diam., but without any corticating rhizoids; main axis 170–210 μ diam., the rather thick-walled cells 1.2 1.9 mm. long below, but in the central part of the plant a little more slender though longer, to 2.5 mm.; principal branching rather regularly opposite, intermediate branching frequently alternate, but ultimate determinate branches regularly opposite and (probably) distichous, with the branchlets producing rather loose plumes, at least near the ends of the last indeterminate branches; branchlets usually first formed unilaterally on the upper side of the lesser branches, sometimes distichously, or on the lower side, or irregularly, usually incurved and about 6 10 cells long, about 42–57 μ diam. near their basis with cells 84–150 μ long, but the cylindrical terminal cells 35–42 μ diam., 85–185 μ long, obtuse-rounded at the tips; tetrasporangia seriate on the upper side of the branchlets, sessile, erect, oval, 55–63 μ long, 47–55 μ diam.; gland cells apparently absent.

Chile: Bahía Tandy, with tetrasporangia (Hassler 2043).

References: Hooker and Harvey 1847, p. 490 (as *Callithamnion flaccidum*); Cotton 1915, p. 491.

BALLIA CALLITRICHA (C. Agardh) Montagne. — Falkland Islands:

Port Stanley (Schmitt 112), York Point, April 24, 1927 (Schmitt). Chile: Punta Arenas (Hassler 2001), Punta Arenas, Feb. 5, 1927 (Schmitt 283), Punta Famine (Hassler 2006), Bahía Tandy (Hassler 2014).

References: Montagne 1842, p. 9 (as *B. Hombroniana*); Hooker and Harvey 1847, p. 488 (as *B. Brunonis* v. *Hombroniana*); Ardissone 1888, p. 212; Hariot 1888, p. 59; De Toni 1889, p. 24; Reinsch 1890, p. 375; Reinbold 1908, p. 199; Gain 1912, pp. 75, 121; Cotton 1915, p. 190; Kylin and Skottsberg 1919, p. 70; Skottsberg 1923, p. 61.

BORNETIA ANTARCTICA (Hooker f. & Harvey) De Toni. — Chile: Bahía Tandy (Hassler 2037).

References: Hooker and Harvey 1847, p. 488; Hariot 1888, p. 60 (as *Griffithsia antarctica*); Gain 1912, p. 123; Cotton 1915, p. 189; Kylin and Skottsberg 1919, p. 66; Skottsberg 1923, p. 57.

CALLITHAMNION FELIPPONEI Howe. — Uruguay: Puerto la Paloma, Dec. 6, 1925 (Schmitt 276, 291, det. M. A. Howe), Punta del Este, March 18, 1932 (Jordan C-c-1).

Reference: Howe 1931, p. 609.

CALLITHAMNION MONTAGNEI Hooker f. & Harvey. — Argentine Rep.: "Golfo de San Matias [probably Cabo Buen Tiempo], 12 Mar. 1872" (Hassler).

References: Hooker and Harvey 1847, p. 490; Cotton 1915, p. 190; Kylin and Skottsberg 1919, p. 66; Skottsberg 1923, p. 61.

Callithamnion uruguayense, sp. nov. — Plants to 2.5–3.5 cm. tall, rose-red or darker, bushy, the lower branches entangled, the upper free and complanate with percurrent main axes; chief branching irregularly alternate, upper branches ascending, habit pyramidal; branchlets distichous, alternate, rigid, tapering, gradually sharply acute, ascending above, below divergent and recurved, as the short branches frequently are; axis near the base with several long rhizoidal attaching branches, but without cortication; main axis near the base straight, about 115 μ diam., the cells about 100 μ long; near the center of the plant the axes still straight, 100–115 μ diam., the cells 200–220 μ long; in the upper part of the plant the axes slightly flexuous, 50–56 μ diam., the cells 210–330 μ long; branchlets simple or subsimple, occasionally converted into short axes, tapered from the base to an acute tip, straight above, arcuate-recurved in the lower part of the plant,

320–630 μ long, near the base 33–37 μ diam., the cells 55–60 μ long, those near the tip somewhat shorter; tetrasporangia usually 1–3 (5) together, seriate on the upper side of the branchlets, sessile, erect, oval, 50–55 μ long, 42–45 μ diam.; cystocarpic plants more irregular in form than the tetrasporic individuals, the cystocarps lateral, paired, erect, each oval section 175–210 μ long, 95–100 μ diam. Pl. III, Fig. 1; Pl. VI, Figs. 1–4; Pl. VII, Fig. 1.

Uruguay: Punta del Este, among rocks, April 11, 1925 (Herter 77903), washed ashore, carposporic, March 16, 1932 (Jordan A–b–1), tetrasporic, March 18, 1932 (Jordan C–a–1 TYPE), Isla de Lobos, washed ashore, March 22, 1932 (Jordan E–b–1).

Planta fruticulosa, inferiore parte intricata ecorticata, superne camplanata, ramulis alternis distichis, rigidis, angustissime acutis, superioribus ascendentibus, inferioribus recurvis; tetrasporangiis seriatis sessilibusque in parte ramulorum superiore; cystocarpiis lateralibus binis. Tab. III, Fig. 1; Tab. VI, Figg. 1–4; Tab. VII, Fig. 1.

Uruguay, in loco dicto Punta del Este, legit Phoebe Jordan.

CERAMIUM DIAPHANUM f. STRICTOIDES H. E. Petersen. — Isla de Lobos, washed ashore, partly on Amphiroa, March 22, 1932 (Jordan E–g–1, E–e–1). Argentine Rep.: Puerto Antonio (Hassler 1115), "San Matias Bay [probably Cabo Buen Tiempo], 12 Mar. 1872" (Hassler 1114 B). Falkland Islands: Port Stanley, March 16, 1927 (Schmitt 219). Chile: Punta Arenas, Feb. 4, 1927 (Schmitt 317), Bahía Tandy (Hassler 2025). Determinations by H. E. Petersen, 1933.

Reference: Petersen 1908, p. 88.

This species in the broad sense has often been reported from southern waters; since Petersen referred all of this material to his f. *strictoides* it is probable that he would so assign at least part of the earlier-recorded material from the same area. The earlier references are therefore significant: Hooker and Harvey 1847, p. 488; Hariot 1888, p. 62; Gain 1912, p. 124; Cotton 1915, p. 191 (det. H. E. Petersen); Kylin and Skottsberg 1919, p. 75; Skottsberg 1923, p. 62; Taylor 1931, p. 30, 1937, p. 335.

CERAMIUM MINIATUM Suhr in J. Agardh. — Plants to 4 cm. tall, axes percurrent, alternately divided, the lesser branches progressively shorter, probably distichous, from alternate becoming subdichotomous; small adventitious branchlets often present, stout branch

tips pointed, divergent, acute, closely branched, 55–85 μ diam., upper branches about 120 μ diam., the nodes and internodes cylindrical; central axes to 560 μ diam. in the strongly protuberant nodes, the internodes 300 μ diam., in the lower parts of the plant more slender; nodes in upper part nearly touching, in the central part separated by more than their width, in the lower part again narrower; cortication at the nodes in the upper part of the plant mostly above the node, which consists of a row of large deep-placed cells partly covered by smaller irregularly oval ones, which form a fairly straight lower margin but above are a little smaller and form a less regular upper margin; nodes of the central part with more numerous deep rows of cells, the smaller outer cells more elongate; emergent tetrasporangia common in the small adventitious branchlets, and also in the upper part of the nodes of the axis; cystocarps on the upper branches, little exceeded by the 3–4 stout, acute involucral branchlets; spermatangial plants not seen. Pl. IV, Fig. 2; Pl. VII, Figs. 2 4.

Uruguay: Punta del Este, tetrasporic, Nov. 15, 1925 (Schmitt 82), Puerto la Paloma, carposporic, Dec. 6, 1925 (Schmitt 277, det. H. E. Petersen).

The original locality for this species appears to have been Peru. This fact encourages a certain caution in attributing Uruguayan material to the species; however, in the lack of a more detailed original description and access to authentic material the present specimens can be ascribed to *C. miniatum* until opportunity occurs to ascertain possible differences between the Atlantic and the Pacific material.

Ceramium rubrum (Hudson) C. Agardh.- Argentine Rep.: "San Matias Bay [probably Cabo Buen Tiempo], 12 Mar. 1872" (Hassler), Puerto San Antonio (Hassler 1114). Chile: Isla Sta. Magdalena (Hassler 2053), Bahía Laredo, Jan. 22, 1888 (Albatross 52), Punta Arenas, Jan. 31, Feb. 2, 1927 (Schmitt 262, 266), Bahía Tandy (Hassler 2036), Caleta Latitud, Feb. 6, 1888 (Albatross 42); in part det. H. E. Petersen, 1933.

References: Hooker and Harvey 1847, p. 488; Hariot 1888, p. 62; Reinsch 1890, p. 375; Reinbold 1908, p. 199; Gain 1912, p. 124; Cotton 1915, p. 191; Kylin and Skottsberg 1919, p. 74; Skottsberg 1923, p. 62; Taylor 1928, p. 192, 1931, p. 30, 1937, p. 340.

Ceramium variegatum Kützing?- Plants small, bright red, gregar-

ious, to 1.5–2.0 cm. tall, entangled below, above free, the branching dichotomous throughout with occasional small adventitious branchlets; branching wide-angled, generally 80°–100°, except in the youngest forks, where narrower; tips erect to slightly forcipate, stout; dichotomies close, in the middle portions about 2 mm. apart; nodes clearly defined, below to about 0.2–0.3 mm. apart, above closer and in the upper branching both nodes and internodes much shorter than the width of the axis, hardly distinguishable with a hand lens; diameter of the least branches about 120 μ, the nodal bands hardly separated, in the middle portion the diameter about 210 μ, the nodes and internodes about 65 μ long; in the lower part of the plant 210–250 μ diam., the nodes 100 μ, the internodes 210–240 μ long; tetrasporangia especially in nodose adventitious branchlets, about 3–5-whorled in each much-inflated node, eventually partly exposed, relatively large, 65–70 μ diam. Pl. IV, Fig. 1; Pl. VII, Figs. 5–6.

Uruguay: Punta del Este, among rocks, with tetrasporangia, April 11, 1925 (Herter 77901).

The identification of this plant was made some years ago, with reservations, by M. A. Howe, but the present writer has nothing better to offer. From Kützing's figures the chief differences include the much wider angle of branching and less forcipate tips, together with narrower bands of nodal cortication.

EUPTILOTA HARVEYI (Hooker f.) Kützing. — Plants over 3 dm. tall, freely alternately to suboppositely branched, the apical cell clearly dividing obliquely; primary branchlet from each segment at first large, whereas the second is rudimentary, but later becomes nearly equal; cortication rhizoidal, from the bases of the branchlets, the cells elongated. Pl. VI, Figs. 5–6.

Falkland Islands: Stanley Harbor (Schmitt 92). Chile: Isla Sta. Magdalena (Hassler 2051), Bahía Tandy (Hassler 2024).

References: Hooker and Harvey 1845, p. 271, 1847, p. 487; Hariot 1888, p. 61; Reinsch 1890, p. 376 (all as *Ptilota Harveyi*); Gain 1912, p. 123; Cotton 1915, p. 190; Kylin and Skottsberg 1919, p. 69; Skottsberg 1923, p. 61 (all as *Plumaria Harveyi*).

The transverse division of the apical cell characteristic of Ptilota and Plumaria is in contrast to the oblique segmentation found in the writer's material of this species; the rhizoidal cortication is also contrary to the definition of Ptilota.

DELESSERIACEAE

CLADODONTA LYALLII (Hooker f. & Harvey) Skottsberg. — Plants to 12 cm. tall or more, the axis denuded below, divided above, the divisions forming broad lanceolate-serrate blades with a midrib and pinnate lateral veins; margin abundantly beset with small blades at first spatulate, later ovate and lanceolate; tetrasporic plants, bearing occasional scattered sori on the older blades, but fruiting abundantly on the smaller marginal proliferations, the sori in the smallest occupying the membrane lateral to the midrib near the base, in the largest being scattered between the lateral veins and about 0.5 mm. diam.

Falkland Islands: Port William, dredged in 26–28 meters, April 7, 1927 (Schmitt 246). Chile: Punta Arenas, Feb. 5, 1927 (Schmitt 281), Bahía Tandy (Hassler 2031).

References: Hooker and Harvey 1845, p. 252, 1847, p. 471; Ardissone 1888, p. 214; Hariot 1888, p. 72; Reinsch 1890, p. 389; Reinbold 1908, p. 196; Gain 1912, p. 122 (all as *Delesseria Lyallii*); Cotton 1915, p. 185 (as *Glossopteris Lyallii*); Kylin and Skottsberg 1919, p. 43 (as *D. Lyallii*); Skottsberg 1923, p. 36; Kylin 1924, p. 45.

CRYPTOPLEURA FIMBRIATA (Greville) Kylin. — Uruguay: on rocks, on Mytilus, and adrift, Punta del Este, April, 1929 (Herter 54681, 77914); Nov. 15, 1925 (Schmitt 81); March 18, 1932 (Jordan C-b-1), La Paloma, Nov. 7, 1934 (Herter 95010a), March, 1937 (Herter 98571). Pl. II, Fig. 1.

References: Kylin 1924, p. 92; Howe 1931, p. 608; Taylor 1931, p. 26 (as *Nitophyllum fimbriatum*).

Extremely variable, fruiting when quite dwarfed; when well developed the small forked tetrasporic branchlets are conspicuously lateral, but when the plant is ill formed they may be developed to the practical exclusion of any main vegetative blade.

CRYPTOPLEURA LACERATA (Gmelin) Kützing? — Uruguay: Puerto la Paloma, Dec. 6, 1925, carposporic (Schmitt 288).

References: Kylin 1924, p. 86; Taylor 1931, p. 27 (as *Nitophyllum laceratum*).

Only a fragment, when dry 6 cm. high, but to 15 mm. wide above the forks, hence much broader than the specimens assigned to *C. fimbriata*. However, in the absence of tetrasporic plants

and with so little material the determination is not altogether satisfactory. The species has been reported from Brazil as well as from Europe.

DELESSERIA LANCIFOLIA (Hooker f. & Harvey) J. Agardh. — Plants to 3 dm. tall or more, and 9 cm. broad, the membrane delicate, the principal veins chiefly opposite on the strong midrib, but secondary veins usually irregularly placed and anastomosing; surface beset with very many tiny pedicellate-lanceolate proliferations 1–3 mm. long, easily dislodged in mounting; these frequently bore evident young pericarps, which were not found on the main blade of the same specimens.

Falkland Islands: dredged in 26–28 meters on the north side of Port William, April 9, 1927 (Schmitt 257).

References: Hooker and Harvey 1847, p. 470 (as *D. sanguinea* v. *lancifolia*); Hariot 1888, p. 93; Gain 1912, p. 122; Cotton 1915, p. 183 (as *Paraglossum lancifolium*); Kylin and Skottsberg 1919, p. 41; Skottsberg 1923, p. 25; Kylin 1924, p. 24, 1929, p. 7.

DELESSERIA EPIGLOSSUM J. Agardh. — Fragments to 15 cm. tall, the chief blades to 1 cm. broad; freely proliferous from the midrib, bearing small narrowly acute blades; pericarps borne on these blades, solitary on the midribs; tetrasporangial sori extended, lateral to and close beside the midrib.

Falkland Islands: Port Stanley, tetrasporic (Schmitt 96), April 14, 1927, tetra- and carposporic (Schmitt 307).

References: Hariot 1888, p. 93; Gain 1912, p. 122; Cotton 1915, p. 184 (as *Paraglossum epiglossum*); Skottsberg 1923, p. 24; Kylin 1924, p. 24.

HYMENENA LACINIATA (Hooker f. & Harvey) Kylin. — Falkland Islands: Port Stanley (Schmitt 104, 106, 124), March 20, 1927, tetrasporic (Schmitt 251b), April 14, 1927, cystocarpic and spermatangial (Schmitt 306). Chile: Isla Sta. Magdalena (Hassler 2059?, 2071), Punta Arenas, Feb. 2, 1927 (Schmitt 274).

References: Hooker and Harvey 1845, p. 256, 1847, p. 474 (as *Nitophyllum Bonnemaisonii* v. *laciniatum*); Hariot 1888, p. 90; Gain 1912, p. 122; Cotton 1915, p. 182; Kylin and Skottsberg 1919, p. 33; Skottsberg 1923, p. 46 (all as *N. laciniatum*); Kylin 1924, p. 82.

MYRIOGRAMME LIVIDA (Hooker f. & Harvey) Kylin. — Falkland

Islands: Port Stanley, March 20, 1927 (Schmitt 251a). Chile: Bahía Tandy (Hassler 2034).

References: Hooker and Harvey 1845, p. 253, 1847, p. 272; Hariot 1888, p. 89; Gain 1912, p. 122; Cotton 1915, p. 181; Kylin and Skottsberg 1919, p. 31; Skottsberg 1923, p. 45 (all as *Nitophyllum lividum*); Kylin 1924, p. 58.

NITOPHYLLUM FUSCORUBRUM Hooker f. & Harvey. — Plants dull red, to over 3.5 dm. tall, deeply cut into several long irregular lobes 1–3 cm. broad; blades near the base with a distinct midrib showing in section a medullary region of large cells and cortical areas of smaller cells in vertical rows; membrane without apparent veinlets, 2–5 cells thick, in the 3-layered region the surface cells in their longest axes to 40–47 μ, in thickness 14–17 μ, the cells of the median layer underlying 2–4 cells of the surface layers and about 28 μ thick, the cuticle 10–14 μ thick, so that the blade in this region reaches 110 μ; tetrasporangial sori minute, about 0.25 mm. diam., very numerous and scattered all over the blades except about the base.

Chile: Isla Sta. Magdalena (Hassler 2058), Bahía Tandy (Hassler 2028).

References: Hooker and Harvey 1845, p. 254, 1847, p. 472; Hariot 1888, p. 89; Gain 1912, p. 122; Kylin and Skottsberg 1919, p. 32; Skottsberg 1923, p. 45.

PHYCODRYS QUERCIFOLIA (Bory) Skottsberg. — Plants fragmentary, denuded, to 11 cm. tall and blades to 2 cm. wide, with midrib and strong oppositely pinnate lateral veins; pericarps scattered, between the lateral veins; tetrasporangial sori small, to 0.5 mm. diam., or confluent, chiefly irregularly submarginally scattered between the lateral veins.

Falkland Islands: Port Stanley, carposporic (Schmitt 110, 116), March 16, 1927 (Schmitt 228?), March 20, 1927, tetrasporic (Schmitt 252). Chile: Punta Arenas, on tidal flats, Jan. 31, 1927, tetrasporic (Schmitt 261).

References: Hooker and Harvey 1847, p. 471; Hariot 1888, p. 91; Reinsch 1890, p. 386; Gain 1912, pp. 73, 122 (all as *Delesseria quercifolia*); Gepp and Gepp 1912, p. 12; Cotton 1915, p. 185 (as *Schizoneura quercifolia*); Kylin and Skottsberg 1919, p. 44 (as *D. quercifolia*); Skottsberg 1923, p. 35; Kylin 1924, p. 44.

SCHIZOSERIS DAVISII (Hooker f. & Harvey) Kylin. — Plants to over

2 dm. tall, the axis denuded and laterally branched below, the blades above often laterally divided or sparingly proliferous marginally or from the midrib; blades 1–3 cm. wide, with strong midribs and definite sparingly forked, irregularly inserted lateral veins; membrane between the veins showing microscopic veinlets; midrib in section with a medulla of large and small cells intermixed and toward the surface a cortex of smaller cells not in definitely ordered rows; membrane between the veinlets one, occasionally two cells thick, measuring 34–45 μ; pericarps about 0.8 mm. diam., on small veinlets scattered between chief lateral veins; tetrasporangial sori to 0.5 mm. diam., scattered or confluent in rows along the sides of the midrib and chief lateral veins, also to some extent beside the secondary lateral veins, or scattered.

Chile: Bahía Tandy, carpo- and tetrasporic (Hassler 2032, 2033).

References: Hooker and Harvey 1845, p. 252, 1847, p. 470; Hariot 1888, p. 81; Gain 1912, p. 122 (all as *Delesseria Davisii*); Cotton 1915, p. 185 (as *Schizoneura Davisii*); Kylin and Skottsberg 1919, p. 39 (as *D. Davisii*); Kylin 1924, p. 68.

SCHIZOSERIS LACINIATA (Kutzing) Kylin.—Chile: Isla Sta. Magdalena (Hassler 2052), Bahía Sholl (Hassler 34), Bahía Tandy (Hassler 2019)

References: Reinsch 1890, p. 385 (as *Delesseria condensata*); Cotton 1915, p. 184 (as *Pteridium Bertrandii*); Kylin and Skottsberg 1919, p. 40 (as *D. laciniata*); Skottsberg 1923, p. 47 (as *Nitophyllum condensatum*); Kylin 1924, p. 67.

RHODOMELACEAE

CHONDRIA ANGUSTATA (Hooker f. & Harvey) Kylin.—Plants bushy, to 8–9 cm. tall or more, with several long branches from near the base, these like the excurrent axis radially bearing numerous scattered lateral cylindrical branchlets, which become 2 cm. long without dividing, but which may in time develop a few secondary branchlets a few millimeters in length; little variation in diameter, the main axis hardly reaching 1 mm., the branchlets usually over 0.5 mm.

Falkland Islands: Port Stanley (Schmitt 95).

References: Hooker and Harvey 1847, p. 484 (as *Laurencia*

pinnatifida v. *angustata*); Cotton 1915, p. 186 (as *Chondria sp.*); Kylin and Skottsberg 1919, p. 52; Skottsberg 1923, p. 53.

CHONDRIA DASYPHYLLA (Woodward) C. Agardh. — Uruguay: Punta del Este, on rocks and washed ashore, April, 1929 (Herter 84684), March 16, 1932 (Jordan A–d–1).

References: Taylor 1928, p. 170, 1937, p. 359; Howe 1931, p. 609.

HETEROSIPHONIA BERKELEYI Montagne. — Falkland Islands: Port Stanley, April 14, 1927 (Schmitt 309, 97). Chile: Bahía de Posesión, Jan. 18, 1888 (Albatross); Bahía Laredo, Jan. 22, 1888 (Albatross 53, 54), Bahía Tandy (Hassler 2021, 2022).

References: Montagne 1842, p. 5; Hooker and Harvey 1847, p. 480 (as *Polysiphonia Berkeleyi* v.); Ardissone 1888, p. 215; Hariot 1888, p. 105 (both as *Dasya Berkeleyi*); Reinbold 1908, p. 197; Gain 1912, p. 123; Cotton 1915, p. 189; Kylin and Skottsberg 1919, p. 63; Skottsberg 1923, p. 57.

LOPHURELLA HOOKERIANA (J. Agardh) Falkenberg. — Chile: Bahía Laredo, Jan. 22, 1888 (Albatross 55).

References: Hariot 1888, p. 102 (as *Rhodomela Hookeriana*); Cotton 1915, p. 186; Skottsberg 1923, p. 53.

LOPHURELLA PATULA (Hooker f. & Harvey) De Toni. — Falkland Islands: Port Stanley, March 16, 1927 (Schmitt 229). Chile: Punta Arenas, tetrasporic, Feb. 2, 1927 (Schmitt 272).

References: Hooker and Harvey 1845, p. 264, 1847, p. 481; Hariot 1888, p. 102 (all as *Rhodomela patula*); Cotton 1915, p. 187; Skottsberg 1923, p. 54.

POLYSIPHONIA ANISOGONA Hooker f. & Harvey. — Plants small, to 3–4 cm. tall, freely branched, the lower parts with rhizoidal branchlets and probably decumbent; above alternately branched, the branches erect; fourteen pericentral cells throughout, without cortication; below to about 300 μ diam., the segments 200–250 μ long; in the central parts the branches about 120 μ diam., the segments 330–375 μ long; lesser branches about 60 μ diam., the segments 125 μ long; branch origin clearly axillary to the caducous trichoblasts.

Chile: Bahía Tandy (2035, 2038).

References: Hooker and Harvey 1845, p. 265, 1847, p. 478; Hariot 1888, p. 104; Reinsch 1890, p. 368; Gain 1912, p. 123; Cotton 1915, p. 187; Kylin and Skottsberg 1919, p. 53; Skottsberg 1923, p. 55.

Polysiphonia argentinica, sp. nov. — Plants to 6 cm. tall, 1–few arising together; color blackish when dried; habit somewhat pyramidal, with a distinct main axis and several principal wide-spreading branches reaching a diameter of 550 μ; pericentral cells four, the segments uncorticated, to 480 μ long, straight or nearly so; alternately radially branched to about 3 degrees, the branches in the middle parts of the plant to 240 μ diam., the segments 1.5–1.9 diameters long, the branchlets to 125–150 μ diam., with segments subequal or to 1.5 diameters long; on the axis and branches occur numerous stiff erect sharp-tipped determinate (adventitious?) branchlets to 0.5–1.0 mm. long, which are 55–80 μ diam. at the base with segments 50–60 μ long, those toward the tip somewhat shorter; trichoblasts obsolescent, not developing beyond small initials and soon shed, absent from segments on which branches originate; tetrasporiferous branches simple or sparingly divided, little enlarged, 95–110 μ diam., the segments to 110 μ long, the sporangia oval, one to each segment, irregularly spiral in distribution; pericarps scattered on the lesser branches and branchlets, on thick short stalks, generally oval to sometimes depressed-spheroidal, 165–290 μ diam., the pore small, not produced. Pl. III, Fig. 2.

Argentine Rep.: Puerto Antonio, Golfo de San Matias, tetrasporic and carposporic (Hassler 1113).

Plantae solitariae vel subgregariae, atropurpureae fere atrae, pyramidales, ramificatione radiata ternatim alterna, caule primario distincto; cellulis pericentralibus quattuor, ecorticatis; ramulis numerosis determinatis rigidis erectis apiculatis; trichoblastis obsolescentibus, in segmentis ramiferis nullis; ramulis tetrasporangia ferentibus simplicibus vel sparse ramosis; pericarpiis non aggregatis, in stipitibus brevibus crassis sitis, ovoideis vel depresse sphaericis; poro parvo haud producto. Tab. III, Fig. 2.

Argentina, in loco dicto Puerto Antonio, legit "Hassler Expedition."

Polysiphonia Hassleri, sp. nov. — Plants erect to 1 dm. or more, arising singly from disclike holdfasts, bushy, the ultimate branching soft and subcorymbose-tufted, coarse dark brownish pink and closely adherent to paper when dried, the lower divisions naked of branchlets and not adhering; axis widely and subdichotomously forked below the main branches, to 1.25 mm. diam., composed

of five pericentral cells about the central row, these individually reaching 300 μ diam., and with about three layers of cortical cells around them, showing no segmentation through the cortication; upper branching progressively less dichotomous and more alternate, the main divisions to 160 μ diam., segments about 125 μ long, and showing little cortication; lesser branches and branchlets flaccid, the branchlets 42–50 μ diam., with segments 50–65 μ long, arising in the axils of the evident trichoblasts; spermatangial clusters, usually accompanied by trichoblasts, on 1-celled stalks, blunt cylindrical-lanceolate, without specialized tip cells, to 330 μ long, 66 μ diam. Pl. V, Fig. 2.

Argentine Rep.: Puerto Antonio, Golfo de San Matias, growing on small stones, spermatangial (Hassler 1111).

Plantae fruticulosae ex basi disciformi, sursum corymbose denseque ramosae, ramis alternis gracilibus tenuibus, deorsum ramis dichotomis crassiusculis, deramulosis, valde corticatis; cellulis quinque pericentralibus; trichoblastis conspicuis cum ramis propriis eis axillaribus; claviculo spermatangifero anguste subcylindrico vel ellipsoideo, apice obtuso. Tab. V, Fig. 2.

Argentina, in loco dicto Puerto Antonio, legit "Hassler Expedition."

This plant has quite the habit of some early-season forms of *P. elongata*, except for somewhat different branching below. The axillary origin of the trichoblasts and the five pericentral cells amply distinguish this very distinct species.

POLYSIPHONIA MICROCARPA Hooker f. & Harvey? — Uruguay: Punta del Este, among submerged rocks and in pools, April, 1929 (Herter 84687b), March 17, 1932 (Jordan B-e 3). Argentine Rep.: Puerto Antonio, Golfo de San Matias (Hassler 1114).

References: Hooker and Harvey 1845, p. 265, 1847, p. 479; Gain 1912, p. 123; Skottsberg 1923, p. 55.

The Herter specimen was determined, with some reservations, by M. A. Howe; the Jordan material is rather more like Harvey's figure (*loc. cit.*, pl. 182, part 3).

POLYSIPHONIA VIRGATA (C. Agardh) Sprengel. — Uruguay: Punta del Este, on rocks, Nov. 15, 1925 (Schmitt 76, det. W. A. Setchell), washed ashore, March 16, 17, 1932, tetrasporic (Jordan A-e-1, B-b-1), Puerto la Paloma, Dec. 6, 1925 (Schmitt 290), Piriápolis, on submerged rocks, Sept. 20, 1930 (Herter 86198).

References: Hariot 1888, p. 105; Gain 1912, p. 123; Howe 1931, p. 609.

PTERONIA PECTINATA (Hooker f. & Harvey) Schmitz. — Falkland Islands: Port Stanley, April 14, 1927 (Schmitt 305).

References: Hooker and Harvey 1845, p. 267 (as *Polysiphonia pectinata*), 1847, p. 482; Hariot 1888, p. 106; Reinsch 1890, p. 373 (all as *Dasya pectinata*); Gain 1912, p. 123; Gepp and Gepp 1912, p. 81; Cotton 1915, p. 188; Kylin and Skottsberg 1919, p. 54; Skottsberg 1923, p. 55.

Rhodomela patagoniensis, sp. nov. — Plant soft and bushy, dark brown when dried, to about 15 cm. tall, with denuded main axis 0.9–1.2 mm. diam., and several spreading main branches which remain distinct to the upper divisions; axis in section showing a distinct central siphon, generally four large cells adjacent to it and other large ones a little displaced, these enclosed by smaller subcortical and yet smaller surface cells; branches bearing numerous alternate secondary divisions which redivide, eventually on the lesser members (1–2 cm. long) showing numerous alternate corticated branches together producing somewhat penicillate tufts; sterile branchlets slender, acute, subsimple, where fertile becoming nodulose, to 70–105 μ diam., the sporangia oval to spherical, 60–70 μ diam., single at the nodes; trichoblasts abundant near the tips of the branchlets; plant when dried adhering well to paper, which may be considerably discolored. Pl. V, Fig. 1.

Argentine Rep.: Puerto Antonio, Golfo de San Matias (Hassler 1112).

Planta mollis, fruticulosa atrobrunnea, inferiore parte denudata, ramis pluribus divergentibus, distinctis praedita; ramis secondariis numerosis alternis; ramulis patentibus corticatis, si sterilibus gracilibus, aut si tetrasporangia ferentibus, nodulosis; trichoblastis prope ramulorum apices abundantibus. Tab. 5, Fig. 1.

Argentina, in loco dicto Puerto Antonio, legit "Hassler Expedition."

The plants of this proposed species are more densely and yet more softly bushy than the northern types in the genus.

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Major parts of two plants of *Epymenia falklandica;* the right-hand specimen shows the tetrasporangial leaflets. × 0.43

FIG. 1. Major part of a plant of *Cryptopleura fimbriata*, showing habit and the small tetrasporangial branchlets. × 0.8

FIG. 2. Plant of *Rhodymenia Schmittii*, complete except for a few lateral branches, showing habit and, near the base, two branchlets with tetrasporangial sori. × 0.5

1

2

FIG. 1. Upper part of a tuft of *Callithamnion uruguayense*, tetrasporangial, showing habit and details of branching. × 6.0

FIG. 2. Small plant of *Polysiphonia argentinica*, showing branching of a tetrasporic plant (left) and of a cystocarpic plant. × 1.5. Fragments of *Dictyota sp.* and *Ceramium rubrum* also appear

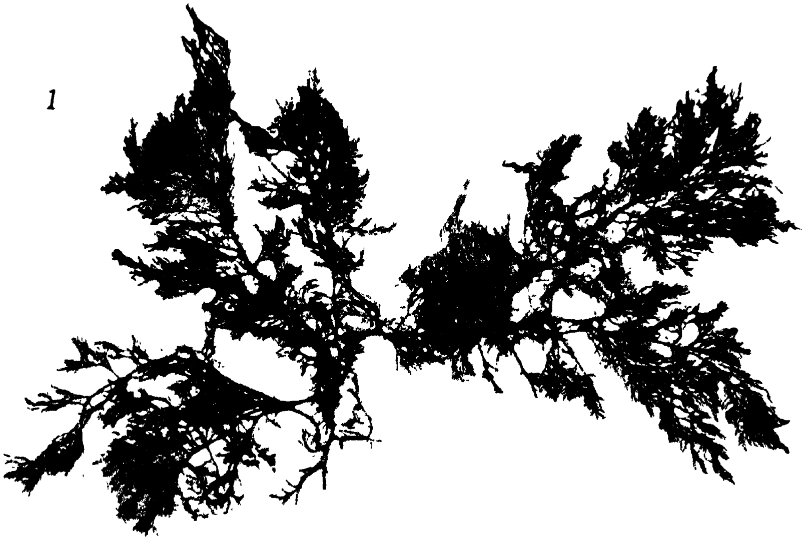
1

2

FIG. 1. Plant of *Ceramium variegatum*, showing branching. × 2.2

FIG. 2. Plant of *Ceramium miniatum*, showing habit of a tetrasporangial specimen. × 2.0

1



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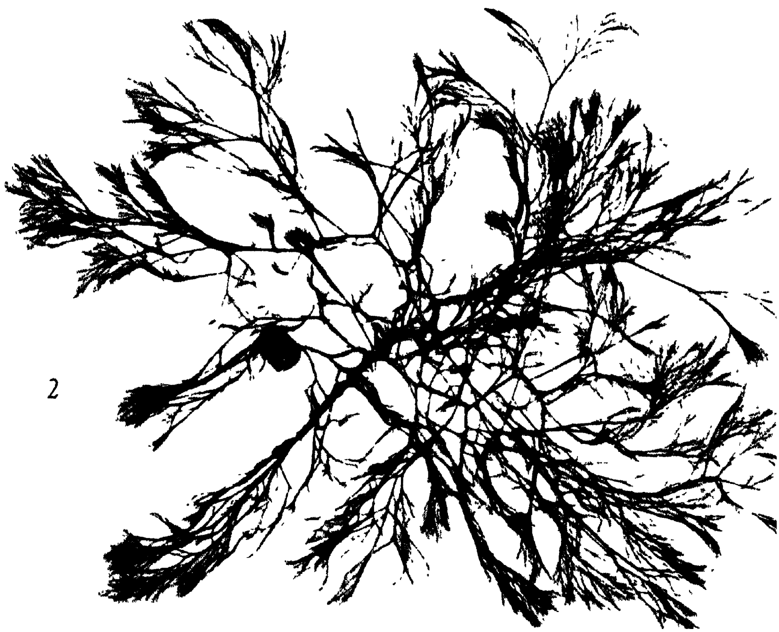


FIG. 1. Plant of *Rhodomela patagoniensis*, showing the habit of a tetrasporangial specimen. × 0.75

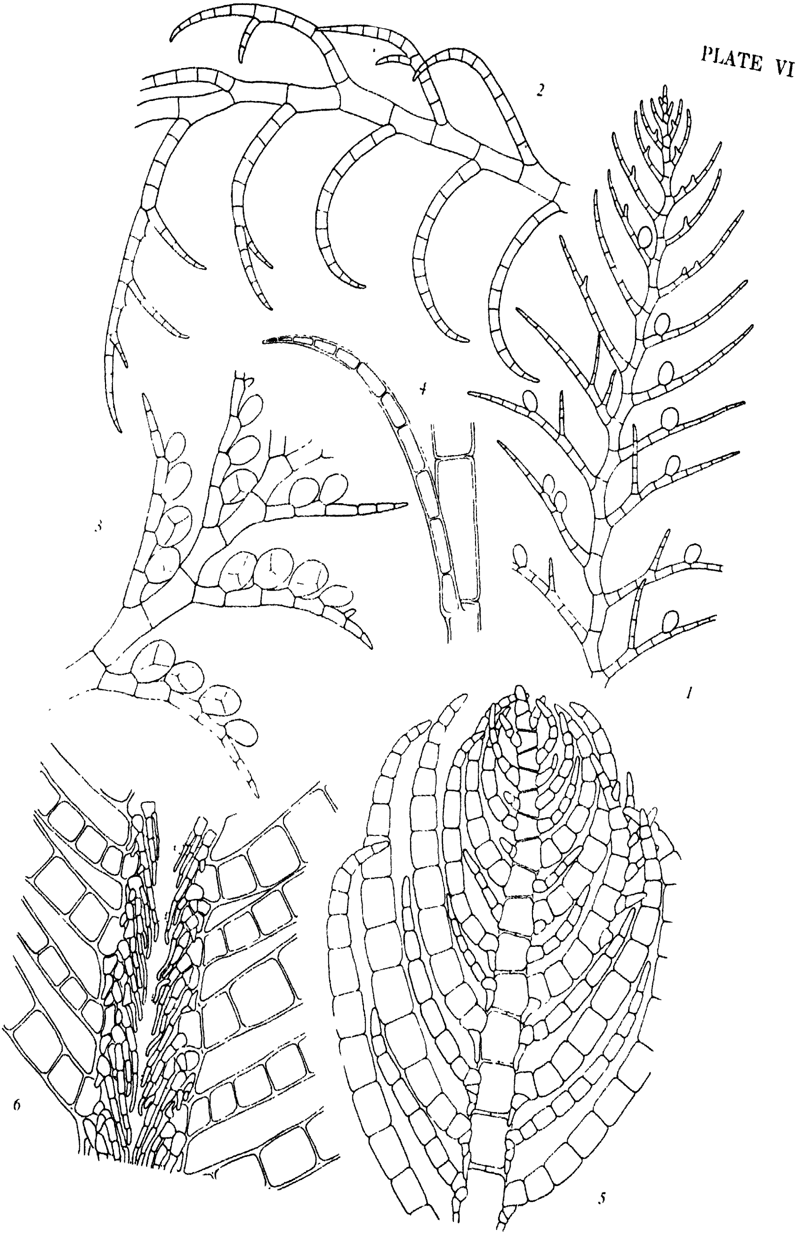
FIG. 2. Plant of *Polysiphonia Hassleri*, showing the habit of a tetrasporangial specimen. × 0.75

EXPLANATION OF PLATE VI

FIGS. 1–4. Details of *Callithamnion uruguayense*, showing structural features Fig. 1, upper part of young tetrasporangial specimen, × 65. Fig. 2, lower part of a main axis, showing recurved branchlets, × 65. Fig. 3, part of a tetrasporangial branch, with sporangia of graduated ages on the branchlets, × 145. Fig. 4, detail of a branchlet, × 145

FIGS. 5–6. Details of structure of *Euptilota Harveyi!* Fig. 5, tip of a main branch showing oblique apical segmentation and subsequent transverse readjustment of the walls of the axial cell row; cortication by downgrowths from the branchlets is beginning, × 145. Fig. 6, part of a slightly older region, showing more advanced bilateral encroachment of the cortication, × 145

PLATE VI

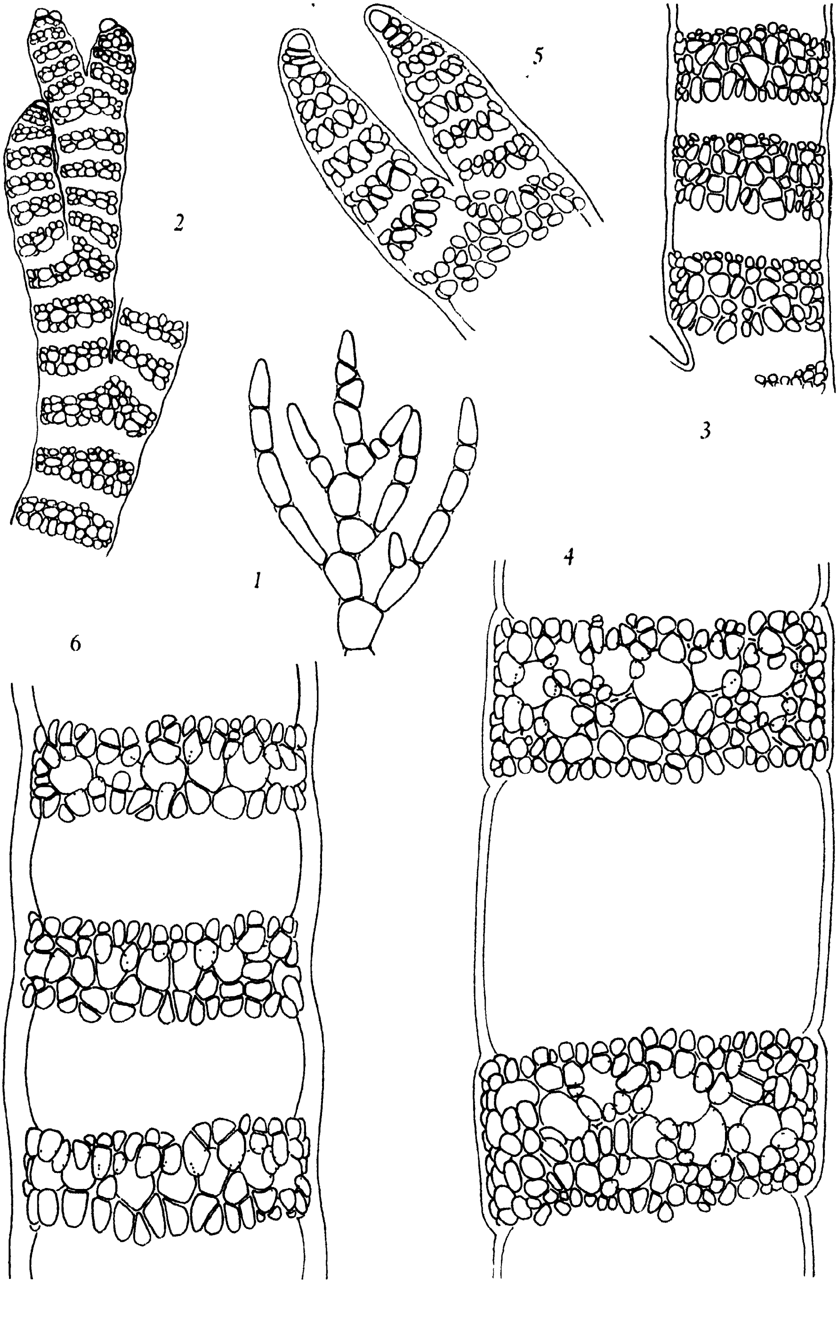


EXPLANATION OF PLATE VII

FIG. 1. Tip of axis of *Callithamnion uruguayense*, showing segmentation, × 290

FIGS. 2-4. Details of structure of *Ceramium miniatum*. Fig 2, fragment of axis showing apical growth of a forking lateral branch, × 175 Fig 3, three segments in the upper branching, showing immature cortication, × 175. Fig. 4, two successive nodes and internode, showing full development of the nodal cortication, × 175

FIGS. 5-6. Details of structure of *Ceramium variegatum*. Fig 5, forked tip, × 225. Fig. 6, three nodes and intervening internodes, showing full development of the nodal cortication, × 225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FORESTRY

SOME RESUPINATE POLYPORES FROM THE REGION OF THE GREAT LAKES. X

DOW V. BAXTER

THERE is great variation among northern wood-inhabiting fungi in their ability to grow on different species of trees. Although many of these fungi exist naturally under widely dissimilar forest conditions, certain plants are found only on conifers, whereas others occur only on hardwoods. *Poria tacamahacae*, sp. nov., attacks the genus Populus, for example, and is not present on conifers, even though spruces are the most abundant trees in the muskegs of the Northwest Territories. Other polypores, which are described as coniferous forms and are found only on conifers in the United States, may go over to hardwoods in the Arctic regions. I have discovered *Poria xantha* to be as common both on Salix and on Picea in certain sections of the Mackenzie River District of the Northwest Territories as it is farther south on coniferous woods only. Even though the spruce isolate may be readily cultured on gum and other hardwood blocks in the laboratory, this fungus is thought to be primarily a coniferous species.

The synopsis of the resupinate polypores included in the present paper of this series is based chiefly upon numerous collections which I have been making in the various forest regions of the Great Lakes and elsewhere in the continental United States, Alaska, the Yukon Territory, and the Mackenzie District of the Northwest Territories.[1]

[1] Throughout the work upon these monographs I am indebted to many individuals and institutions for help, suggestions, and privileges extended to me. My appreciation is expressed particularly to the men who have accompanied me on my six expeditions to Alaska, the Yukon Territory, and the Northwest Territories. Much credit is due them for aiding in the collection and care of specimens and for living, at times, under rather difficult circumstances. I am under obligation to Professors T. G. Halle and Gunnar Samuelson, of the Naturhistoriska Riksmuséet in Stockholm, with whom I have had the pleasure of association. Thanks are due several American institutions and scholars also. To the authorities at the New York Botanical Garden, to Dr. H. D. House, at the New York State Museum, to Dr. W. H. Long, Albuquerque, New Mexico, and to the staff of the Division of Pathological and Mycological Collections of the United States Department of Agriculture, I am particularly indebted.

TABLE I

Growth Characteristics of Resupinate Polypores on Malt Agar

Name	In Light						In Dark				
	Rate in mm 2 weeks	Color (Ridgway)	Texture and form	Character of margin	Agar discoloration	Pore formation	Rate in mm. 2 weeks	Color (Ridgway)	Texture and form	Agar discoloration	Pore formation
Poria betulina on *Betula occidentalis* from Hope, British Columbia	41	"Buckthorn brown"	Chamois	Indefinite	None beyond mycelium	None	41	"Tawny-olive"	Chamois	None	None
Poria pulchella on *Populus balsamifera* from Great Slave Lake, Northwest Territories	41	"Ivory yellow" to "colonial buff"	Silky, concentric-ring, radiating growth	Indefinite	None	Present	41	White to "Marguerite yellow"	Silky to chamois, radiating	None	Limited
Polyporus anceps on *Picea glauca* from Fort Wrigley, Northwest Territories	41	White	Cottony, radiating	Indefinite	None	None	41	White	Cottony	None	None
Poria xantha crassa on *Salix interior* from Providence, Northwest Territories	39	"Pale chalcedony yellow" to "Marguerite yellow"	Silky to granular	Indefinite	None	Present	41	"Seafoam yellow"	Arachnoid to granular	None	Present
Poria xantha crassa on *Picea glauca* from Fort Wrigley, Northwest Territories	33	White to "massicot yellow"	Arachnoid to chamois	Indefinite	None	None	41	"Massicot yellow"	Silky to cottony	None	None
Poria subacida on *Acer circinatum* from Hope, British Columbia	34	White to "pale pinkish buff"	Silky, some concentric-ring growth	Indefinite	None	None	41	White	Chamois to cottony	None	None
Poria tacamahacae on *Populus balsamifera* from Alberta	41	White	Cottony, radiating	Indefinite, cottony	None	None	41	White	Cottony, radiating	None	None

Most of these fungi are to be found in the forests of Michigan, Wisconsin, and Minnesota. Descriptions of twelve resupinate polypores are given here, among them two new species. The characteristics of seven resupinate polypores in culture are discussed, and their growth features are presented (see Table I).[2]

Poria tacamahacae, sp. nov.

(Plate I)

Type and important specimen:

Poria tacamahacae, sp. nov., on *Populus balsamifera*, Fort Smith, Northwest Territories, Canada. Type. Coll. Dow V. Baxter, Aug. 20, 1937. Herb. Dow V. Baxter, Ann Arbor.

Poria tacamahacae, sp. nov., on *Populus balsamifera*, Waterways, Alberta. Coll. Dow V. Baxter, Aug. 11, 1937. Herb. Dow V. Baxter, Ann Arbor.

Planta resupinata, cum fructificatione annua, late effusa vel sequens rimas corticis usque ad 0.7 metrum; planta viridans albida vel pallide viridis, aliquando nitida, margine conspicue albido; planta sicca saepe formans tenuem membranosam laminam circiter 1.5 mm. crassam; subiculum manifestum, album vel ochraceum, usque ad 2 mm. crassum, sed plerumque minus; margo, ut in genere Stereo, albidus, ochraceus vel pallide olivaceo-ochraceus, usque ad 5 mm. latus; tubi plerumque circiter 2 mm. longi, aliquando 3.5 mm.; aperturae albidae vel primum pallide virides; siccitate pallide ochraceae, et in speciminibus crassis aliquando fulvae; 5-6 in uno mm.; basidia 9-18 × 3-4 μ, copiosa et transversaliter visa annulum conspicuum formantia; sporae 4-5.5 × 1 (2) μ; hyphae hyalinae, ramosae, angustae, plerumque 1-3 μ diam.; cystidia et anastomoses desunt. Specimen typicum in Herb. Dow V. Baxter conservatum: As 2-3155-b.

Fructification annual, resupinate over large areas or following the crevices of the bark for as much as 0.7 of a meter; when fresh appearing whitish to very pale green, somewhat glossy, and with a distinct whitish margin, plant often drying down and forming a thin skinlike sheet about 1.5 mm. thick over the bark; subiculum conspicuous, white to "cartridge buff," up to 2 mm. thick, mostly less; margin stereum-like, whitish, "cartridge buff," or "pale olive-buff," up to 5 mm. wide; tubes mostly about 2 mm. long,

[2] The terms used in this classification are defined in Papers V-VI (1-2) of the series.

at times up to 3.5 mm.; mouths whitish or very pale green at first, drying "cream-buff," "colonial buff," and in thick specimens sometimes "Verona brown," 5–6 to a mm.; basidia 9–18 × 3–4 μ, abundant and in cross section appearing as a definite and conspicuous ring lining the tubes; spores 4–5.5 × 1 (2) μ; hyphae hyaline, much branched, narrow, mostly 1–3 μ in diameter; no cystidia and no clamp connections.

Allied species. — This distinctive plant is readily recognized by its pale greenish white pore surface when fresh. Although some of this color may be detected in the dry state, much of the pore surface has acquired colors which suggest those of *Poria subacida.* The spores will readily separate the two plants from each other. They are not at all related in microscopic features. Because *P. tacamahacae* is found on balsam poplar and because thick forms of this species are similar in color in the dried state to *Poria corticola,* the two porias may be readily confused. However, the distinct cystidia which are present in *P. corticola* are not found in *P. tacamahacae. P. tacamahacae* suggests *Polyporus pallescens,* especially in the stereum-like borders of the two plants. But the spores of *P. tacamahacae* are longer and the plant, when fresh, exhibits a greenish cast which is not present in *Pol. pallescens. P. tacamahacae* may also suggest *Pol. pannocinctus* (which is probably *Pol. semipileatus*). *Pol. pannocinctus* (and for that matter, *Pol. pallescens*) does not exhibit the pronounced glassy appearance which is characteristic of *P. tacamahacae.* The growth habits of the three plants are different also. *P. tacamahacae* grows over large surfaces and in the crevices of the bark of logs, whereas *Pol. pannocinctus* and *Pol. pallescens* occupy restricted areas of the substratum.

P. tacamahacae is to be found in various herbaria (chiefly European) and, together with many other species, is doubtfully classified under the name *Pol. vitreus.* Donk (5) has described the spores of *P.* (*Podoporia*) *vitrea* Fr., non Pers! as globose 4.25–5 μ and lists "*Pol. undatus* Pers. Myc. Eur. 2 : 90 (t. 16 f. 3), 1895; Lloyd Syn. Apus Pol. 321 (f. 662, 663), 1915; *Poria undata* (Pers.) Bres. in Ann. Myc. 1 : 78, 1903; Bourd. et Galz" under that species as synonyms. I could find no evidence in Holland or in Sweden that the American plant should be called *Pol. vitreus* — even though it has been found in herbaria occasionally,

but always doubtfully, classified under that name by later collectors who followed Persoon and Fries. The spores of the American plant should readily separate it from the plant Donk records. When small collections are found, care must be taken to note their colors when fresh and also their glassy appearance, if *P. tacamahacae* and *P. subincarnata* (Pk.) Murr. are to be separated. Since *P. subincarnata* is ordinarily found growing in small patches, little difficulty will be experienced in distinguishing the naturally large sheets of *P. tacamahacae* from it. Occasionally, however, collections of *P. tacamahacae* which cover only a small area of bark or wood are encountered. The citron-white (not incarnate) color of this fungus when fresh, the glassy appearance of the mouths, and the fact that *P. tacamahacae* is found on hardwoods are features which may be used to separate the two. There are few species of the genus Poria found on *Populus balsamifera.*

Cultures. — Isolated from *Populus balsamifera,* Waterways, Alberta. It belongs to the "rapid-growth" class and also to those groups termed "average temperature" and "large range." It grows best in the dark.

Habitat. — *Populus balsamifera, P. trichocarpa.*

Distribution. — Alberta, Northwest Territories, Idaho, Michigan, Nebraska, New York.

Remarks. — It is believed that this plant has a much wider distribution, especially throughout the West, than the available records indicate. It is one of the most common resupinate polypores found in certain sections of the Northwest Territories.

Poria myceliosa Peck, N. Y. State Mus. Bull., 54:952. 1902

Type and important specimen:

Poria myceliosa **Pk. on hemlock, Floodwood, New York. Type. C. H. Peck. New York State Museum, Albany.**

Poria myceliosa **Pk. on hemlock, Frankfort, Michigan. E. T. Harper 526164. Field Museum of Natural History, Chicago.**

Fructification annual, effused for 17 or more centimeters over very rotten wood, mostly less than 1 mm. thick, separable; margin white to "cartridge buff," "warm buff" to "clay color," sterile,

fimbriate or rhizomorphic; subiculum less than 0.5 mm. and scarcely visible in mature plants; tubes first developing as shallow depressions in the subiculum, up to 1 mm., but usually less than 0.5 mm. in length; mouths pale yellow at first but in herbarium material becoming "light pinkish cinnamon," "pinkish buff" to "cinnamon-buff," 2–4, mostly 3 to a mm.; becoming confluent, angular; dissepiments thin; basidia 2–4-spored, 14–18 × 3–5 μ; spores ellipsoidal, smooth, hyaline, often guttulate, 2–3 × 3–4 μ; no cystidia; tramal hyphae with thin walls, open, hyaline, rarely encrusted, 2–5.5 μ in diameter, clamp connections present. Mycelial strands abundant in the badly decayed wood.

Allied species. — This species, while in certain stages of development, may be confused with Porothelium. The fact that the tubes first develop as shallow depressions in the subiculum should readily separate the two. Because of the somewhat yellowish color of the plant when fresh, *Poria myceliosa* has been confused with *P. albolutescens* Romell. This latter plant remains yellow, however, and does not turn "pinkish buff" or "cinnamon-buff" in the herbarium. *P. fimbriatella* differs from *P. myceliosa* in the presence of encrusted cystidia and in the absence of clamp connections.

Habitat. — *Populus balsamifera, Quercus sp., Tsuga canadensis.*

Distribution. — Ontario, Alaska, Michigan, New York, Virginia.

Remarks. — This plant is not common. Overholts (8) calls attention to the membranaceous subiculum, the short tubes, the rhizomorphic strands, and the small pores as characteristic features.

Poria albobrunnea (Romell) Baxter, comb. nov.

Polyporus albobrunneus Romell *p. p.*
Poria dichroa Bres., Mycologia, 17: 75. 1925.

Types and important specimens:

Polyporus albobrunneus Romell on *Pinus silvestris*, Lakaträsk. Herb. Mycolog. Lars Romell 12241, Stockholm.

Polyporus albobrunneus Romell, coniferenholz, 1910. Herb. Mycolog. Lars Romell 12240, Stockholm.

Poria albobrunnea (Romell) Baxter on *Tsuga heterophylla*, Wrangell, Alaska, 1935. Dow V. Baxter. Herb. Dow V. Baxter 5909K, Ann Arbor.

Poria albobrunnea (Romell) Baxter on white spruce, Fort Wrigley, Northwest Territories, 1937. Dow V. Baxter. Herb. Dow V. Baxter 2–2503–d, Ann Arbor.

Poria albobrunnea (Romell) Baxter, Lake Louise, Alberta, 1933. Dow V. Baxter. Herb. Dow V. Baxter 2–2504, Ann Arbor.
Poria albobrunnea Romell on old windfall at Nat. Pole Co., Cerca Meadow Creek, Idaho, Aug. 10, 1919. Coll. E. E. Hubert. Ex. Herb. James R. Weir.
Poria dichroa Bres. on *Larix occidentalis*. Ex. Herb. James R. Weir. Division of Pathological and Mycological Collections, Washington.

Fructification annual or perennial, fragile, soft, or becoming somewhat felty in large, thick specimens produced in regions of much rainfall, entirely resupinate, effused for as much as 0.5 of a meter and up to 12 mm. thick in such specimens, but usually much less; margin pubescent, mostly 2 mm. wide but sometimes 7 mm. or more, white to "Verona brown," often turning blackish and in thick specimens bordered by tubes which appear resinous; mouths snow-white at first, often turning "warm buff," "wood brown," "benzo brown," to "Prout's brown" in old specimens found in the field or in the herbarium, 3–5 to a mm.; spores hyaline, allantoid, 6 × 1.5 μ; hyphae undulate, no clamp connections present, 3–4 μ in diameter; mycelium forming cottony wefts throughout the friable rotten wood, which readily breaks up into dusty fragments when dry.

Allied species. — *Poria albobrunnea* is so closely related to *Polyporus mollis* Fr. (at least to one interpretation of that species) that its author (10) later suggested, "I now admit that this species (*Pol. albobrunneus* Romell) does not differ from *Pol. mollis* in the sense of Fries (Icon. sel. t. 182, f. 3)." Romell did not believe, however, that Persoon, "who is the author of *Pol. mollis*, had in view Fries' species which grows preferably on *Pinus silvestris*." Under the name *Tyromyces fragilis* (Fr.), Donk (5) lists Polyporus Fr., *Leptoporus fragilis* (Fr.) Quél., *Trabeus subsp. L. fragilis* (Fr.) Bourd. et Galz., *Pol. albobrunneus* Romell, and *Pol. mollis* Fr. (non *Pol. mollis* Pers.) as synonyms.

Specimens in the Romell herbarium at Stockholm also show that Romell later considered *Pol. albobrunneus* and *Pol. mollis* Fr. (non Pers.) to be the same. Resupinate specimens labeled *Pol. albobrunneus* there show that the mouths were not generally sinuous or irpiciform as in *Pol. mollis* Fr. American specimens of *P. albobrunnea* are definitely poriform, and do not break up into teeth. Although the mouths of dried European specimens of both *Pol. albobrunneus* and *Pol. mollis* vary greatly in color, from white to dark reds and browns, lighter colors, white to

"vinaceous buff" or "cartridge buff," are predominate in *Pol. albobrunneus.* The mouths of European specimens of *Pol. mollis* are generally shades of dark red or red-brown: "tawny-olive," "snuff brown," "natal brown," or "warm sepia."

The resupinate habit of *P. albobrunnea* should be mentioned. It is true that specimens of *Pol. mollis* Fr. may occasionally be mostly resupinate, like many specimens of *Polystictus abietinus.* When *Polyporus mollis* is found growing in the resupinate condition, it is usual for the edges of the plant to separate from the substratum (just as is customary for dried specimens of *Pol. abietinus* when growing under similar situations). *P. albobrunnea* is constantly resupinate.

In addition to the differences in pore form, and, in a limited degree, in the general color of the mouths and the resupinate habit, texture is an important distinguishing character. While both plants are generally fragile (except the thick forms of *P. albobrunnea*), *Pol. mollis* is fragile in the sense that, when dry, it can readily be crumbled into a powder between the fingers. *P. albobrunnea* is fragile in that it falls to pieces, but it does not fall into dustlike bits and is considerably more coriaceous. The thick specimens of *P. albobrunnea* are definitely leathery. The badly decayed and punky wood found under the fruiting bodies of both plants crumbles into dust and breaks up so readily, however, that it is often difficult to bring specimens from the field into the laboratory in their entirety.

Cultures. — Isolated from *Pinus caribaea,* Cogdale, Georgia. This fungus grows more rapidly in the dark than in the light; it belongs to the "rapid-growth" group of resupinate polypores and falls into both the "large-range" and the "high-temperature" categories. The white mycelium is arachnoid to cottony, and cultures exhibit a cerebriform habit. In neither agar nor wood-block cultures has the mycelium exhibited the browns noted in specimens found in the field. The cottony mycelium grows on both white pine and red gum blocks in a thin rhizomorphic fashion, and, unlike many of the light-colored polypores such as *Poria ambigua, P. incrassata, P. subacida, P. xantha,* and others, does not cover or hide the wood blocks from view. Pore formation has taken place in one-year-old liter flask cultures containing red gum blocks. This naturally conifer-inhabiting fungus has,

however, not produced pores in similarly aged cultures on white pine wood.

Habitat. — *Picea glauca, Pinus caribaea, P. contorta, P. ponderosa, Tsuga heterophylla.*

Distribution. — Alberta, Northwest Territories, Yukon Territory, Alaska, Arizona, Georgia, Idaho.

Remarks. — *P. albobrunnea* should be studied with *Pol. mollis* Fr.; accordingly, the reader is here referred to the preceding comments on *Pol. mollis* and to the discussion and plates of *Pol. fragilis.*

My concept of *P. albobrunnea* is best expressed by stating that it corresponds to descriptions of American specimens under the name *P. dichroa* Bres. That these limits of variation for this species were conceived by Romell is shown by the fact that he determined an American plant to be *P. albobrunnea.* It was collected by E. E. Hubert in Idaho and sent to Romell by James R. Weir. The name "*Poria albobrunnea*" (note genus used by Romell) is written in Romell's handwriting and, furthermore, he listed *Poria dichroa* Bres. on the packet as a synonym. I have compared this collection with cotypes of Bresadolas and find Romell to be correct.

Polyporus fragilis Fr., El., 80. 1828; Hym. Eur., 546. 1874

Tyromyces fragilis (Fr.) Donk in Rev. der Niederländischen Homobasidiomycetae-Aphyllophoraceae. II. No. 9: 148. 1933.

Leptoporus fragilis (Fr.) Quél., Ench., 176. 1886.

Leptoporus trabeus subsp. L. fragilis (Fr.) Bourd. et Galz. in Bull. Soc. Myc. Fr., 41: 123. 1925.

Polyporus mollis Fr., Syst. Myc., 1: 360. 1821; Hym. Eur., 547. 1874? (non *Polyporus mollis* Pers., Myc. Eur., 2: 62. 1825).

Polyporus erubescens Fr. in Swedish Herbaria.

Polyporus mollis erubescens Weinmanni in Herb. Mycolog. Lars Romell, Stockholm.

Polyporus Weinmanni Fr. in Swedish Herbaria.

(Plate II, Fig. 1)

Important specimens:

Polyporus fragilis Fr., Herb. Mycolog. Lars Romell 13490, Stockholm.

Polyporus fragilis Fr., Herb. Mycolog. Lars Romell 13572, Stockholm.

Polyporus fragilis Fr., Uppsala, Sweden, 1934. Coll. Seth Lundell and Dow V. Baxter, det. Seth Lundell. Herb. Dow V. Baxter 5990a, Ann Arbor.

Polyporus fragilis Fr. on *Picea excelsa,* 1898. Herb. Mycolog. Lars Romell 12378, Stockholm.

Polyporus erubescens Fr. on pine stump. Herb. Mycolog. Lars Romell 12352, Stockholm.

Polyporus mollis crubescens det. Romell, 1917. Herb. Mycolog. Lars Romell 13467.

Polyporus Weinmanni Fr. on *Pinus silvestris*. Leg. Bres. Herb. of Bresadola, Stockholm.

Bjerkandera Weinmanni, Mustiala. Leg. P. A. Karsten. Herb. of Bresadola, Stockholm.

Fructification sessile, effuse-reflexed or, often, resupinate, fleshy and soft when fresh, becoming fragile in herbarium specimens or when dry, turning "pinkish buff," but mostly "russet," "Mars brown," or red, when bruised; surface white at first, rugose and fibrous to nearly glabrous, azonate, resupinate specimens up to 1 cm., but mostly less than 5 mm. thick; margin thin, fertile below, and in resupinate specimens 1–3 mm. wide; subiculum white, becoming reddish when bruised or dry, 0.5–1 mm. (1 cm. in reflexed forms) thick; tubes white when fresh, turning "cartridge buff," "pinkish buff," "tawny-olive," to "warm sepia" when dry, 2–8 mm. long; mouths concolorous, circular or angular, becoming sinuous or irpiciform, averaging 3–4 to a mm.; basidia 2–4-spored, 9–26 × 3–5.5 μ; spores hyaline, smooth, cylindrical or allantoid, 4–7 × 1.5 (2) μ; hyphae hyaline to golden brown, occasionally branched, thin-walled, 3–5 μ in diameter; no cystidia or clamp connections present.

Allied species. — *Polyporus fragilis* Fr. is closely allied to *Poria albobrunnea*, and difficulty may be experienced in separating the two if *Pol. fragilis* is found in the resupinate state. Attention is called to the crisp-rigid-fragile nature of resupinate specimens of *Pol. fragilis* as compared with the leathery character of those of *P. albobrunnea;* to the edges of dried specimens of *Pol. fragilis*, which are more likely to curl up and leave the substratum, much as happens in *Pol. abietinus;* to the sinuous pore form in *Pol. fragilis*, contrasted to pores which do not break up or become sinuous-irpiciform in *P. albobrunnea;* and to the generally lighter color of the pores of *P. albobrunnea*. See description of *P. albobrunnea* for additional remarks.

Pol. lapponicus Romell (*Pol. ursinus* Lloyd ?) is another species which is whitish or pinkish when fresh and turns with age or on bruising to red or brown. This species, which has a fibrillose pileus and numerous cystidia, possesses large cylindric-ellipsoid spores measuring 7–12 × 2.5–3.5 μ. There are no cystidia in *Pol. fragilis.*

Habitat. — *Picea glauca*, *Pinus ponderosa*, *P. strobus*, *Pseudotsuga taxifolia*.

Distribution. — Nova Scotia, Ontario, Colorado, Georgia, Idaho, Michigan, Montana, New York, Oregon, South Dakota, Tennessee, Virginia, Washington.

Poria viridans (Berk. and Br.) Sacc., Syll., 6: 304. 1888; Bres., Kmet., 66

Polyporus viridans Berk. and Br., Ann. Mag. Nat. Hist., III, 7: 937. 1861.
Physisporus inconstans Karst., Rev. Myc., 9: 10. 1887.
Polyporus Nuoljae Rom., Hym. Lappl., Arkiv für Botanik, 11: 18. 1911.

(Plate II, Fig. 2; Plate III)

Type, cotypes, important specimens:

Polyporus viridans Berk et Br examplar originale! Anglia, Berkeley in Herb. of Bresadola, Stockholm

Polyporus inconstans Karst on Populus, Mustiala, 1886. P. A. Karsten. Herb. of Bresadola, Stockholm.

Polyporus Nuoljae on *Salix Nuolja*, 1910. Herb. Mycolog. Lars Romell, Stockholm.

Fructification annual, effused in irregular patches up to 9 × 3 cm., on decorticated wood, adnate, 0.5 mm. thick; margin up to 1.5 mm. wide, often becoming fertile, "pale olive-buff," cobwebby; subiculum paper-thin or almost lacking; tubes 0.5 mm. long or less; mouths drying to "cinnamon-buff" to "clay color," 4-7, mostly 5-6 to a mm., thin-walled; basidia 12–20 × 4.5 μ, spored; spores cylindrical or allantoid, hyaline, 4-5 × 1.5 (2) μ; hyphae septate, no clamp connections, 3–7 μ in diameter.

Allied species. — Specimens of *Poria viridans*, because of the colors when dry and because the plants are thin, often suggest *P. eupora*, *Pol. versiporus*, *P. corticola*, and *P. reticulata*. The wider spores of *P. eupora* (ellipsoidal, 3-4.5 × 2-3 μ) will distinguish that species from *P. viridans*. The spores of *Pol. versiporus* and *P. corticola* are also ellipsoidal (4.5-6 (5 × 3.5) 3–3.5 μ and 4-5.5 × 3-3.5 μ, respectively). *P. viridans* differs from *P. reticulata*, which has allantoid spores also, by the spore size and by the fact that the pores are larger in *P. reticulata*, i.e. 2–4 to a mm. The spores of *P. reticulata* are 6–10 (7.9 × 2.5-3) 2–3.5 μ.

Habitat. — *Fraxinus sp.*, *Populus balsamifera*. Known in Europe on

Betula sp., Juglans sp., Populus tremula, Quercus sp., Salix sp., and also on *Pinus excelsa.*

Distribution. — Alaska, Michigan.

Occurrence. – This plant appears to be most common on *Populus tremula* in Europe. It probably occurs much more commonly in North America than the distribution records published here indicate. Perhaps the lack of understanding of the plant accounts for the small number of the collections of this species that exist in American herbaria.

Poria subiculosa (Pk.) Cooke, Grevillea, 14 : 114. 1886

Polyporus subiculosus Peck, 31st Rep. N. Y. State Mus., p. 37. 1879.
Fuscoporia subiculosa (Pk.) Murr., North American Flora, 9 : 4. 1907.

Type and important specimen:

Polyporus subiculosus Peck, Jamesville, N. Y. C. H. Peck. Herb. New York State Museum, Albany.

Poria subiculosa (Pk.) Cooke on cedar, Neebish, Michigan. E. T. Harper. Herb. of Field Museum of Natural History, Chicago.

Fructification annual, or perennial by reviving, separable, effused for 15 centimeters or more, soft, felty, up to 2 mm. thick; margin (subiculum on which the pores are formed) often 2.5 centimeters or more broad, felty, soft, floccose, sterile, "yellow ocher," "antimony yellow," "Sudan brown," "antique brown," usually about 1 mm. thick; tubes 1-2 mm., mostly 1 mm. long; mouths "tawny-olive," "clay color," drying to "mummy brown," angular, 1–3 to a mm.; spores ovoid or broadly ellipsoidal, 4–7 (7×4) 3–5 μ; hyphae of the subiculum thick-walled, cross walls evident, 6–7 μ in diameter, no clamp connections; tramal hyphae brown or sometimes hyaline, occasionally encrusted, 2.5-6 μ in diameter.

Allied species. — This species is not readily confused with any other North American poria. *Poria myceliosa* (perhaps the most likely plant to cause difficulty — because of its descriptive name rather than because of any features of the fungus itself) is not felty and can be separated easily from *P. subiculosa* by color differences alone. *P. myceliosa* has a broad white sterile margin usually ending in rhizomorphs.

Habitat. — *Thuja occidentalis, Tsuga canadensis.*

Distribution. — Michigan, New York, Wisconsin.

Polyporus Farlowii Lloyd, Syn. Apus Pol., 363, f. 697. 1915

(Plate IV, Fig. 1)

Important specimens:

Polyporus Farlowii Lloyd on *Schinus mollis*, Phoenix, Arizona. Coll. and det. W. H. Long 19917.

Polyporus Farlowii Lloyd on *Populus italica*, Albuquerque, New Mexico, 1916. Coll. and det. W. H. Long 21315.

Fructification applanate, 5–18 × 5–10.5 × 2–3 cm., with surface strongly hispid, brown to blackish, and a more or less woody context, 0.5–2 cm. thick, texture drying brittle as in *Pol. cuticularis;* context "clay color"; tubes 1–14 mm. long; mouths "sayal brown," "warm sepia," to dark neutral gray in old specimens, when blackish (dark neutral gray) not defracting light, 1–4 to a mm.; spores pale yellow or brown, 5.5 × 5.5–6.5 μ; hyphae of two types, dark brown, thick-walled, 3–4 μ in diameter, and very pale brown, 4 μ in diameter, no brown setae.

Allied species. *Polyporus Farlowii* resembles *Pol. hispidus* Fr. and *Pol. glomeratus* Pk. in surface color, tube character, and spore color. The fruiting bodies of *Pol Farlowii* are much more woody and less fragile. The spores are colored in all three plants, but in *Pol. glomeratus* they are apt to be greenish brown rather than brown as in *Pol. hispidus* and *Pol. Farlowii.* This feature, however, is often difficult to identify, since immature spores of all three plants may be so pale in their nature that one cannot be certain about shade differentiation. In general, however, the spores of *Pol. hispidus* are larger than those of the other two plants. Those of *Pol. hispidus* are broadly ovoid to ellipsoid, 7–9.5 × 6.5–7 μ; of *Pol. glomeratus*, subglobose, 5–6 μ; and of *Pol. Farlowii*, broadly ovoid to ellipsoid, 5.5–6.5 × 5.5 μ. Woody surfaces of many old specimens of *Pol. Farlowii* are distinctive.

Habitat.—*Acer negundo, Morus alba, Populus dilatata, P. italica, Sambucus neo-mexicana, Schinus mollis.*

Distribution. Arizona, New Mexico.

Remarks. Lloyd (6) calls attention to the fact that the type at Kew was collected in Arizona and that it was sent by Farlow to Cooke, who determined it as *Polyporus endocrocinus.* Lloyd states: "The yellow coloring matter is not soluble in water,

but readily so in a potash solution. This must be an unusual species in our western states."

The fungus is most common in the Southwest, where it causes, according to Dr. Long, a heart rot of living trees. It is common on *Sambucus neo-mexicana* and *Schinus mollis*.

Polyporus illinoisensis, sp. nov.

(Plate IV, Fig. 2)

Type and important specimen:

Polyporus illinoisensis on *Cephalanthus occidentalis*, Vandalia, Illinois. Coll. Dow V. Baxter, 1922. Herb. Dow V. Baxter, Ann Arbor. Type.

Polyporus illinoisensis on *Cephalanthus occidentalis*, Sugar Loaf Lake, Jackson County, Michigan. Coll. C. H. Kauffman, July 4, 1927 Herb. Dow V. Baxter, Ann Arbor.

Fructificatio subresupinata, usque 2 cm. crassa, 5.5 cm. lata, 10 cm. longa, atrobrunnea vel brunnea, vel in speciminibus vetustioribus atrata vel atrogrisea etiamque non diffringens; poris 0.25 1 mm. diam.; sporis flavescentibus vel pâllide brunneis, 3–3.5 μ latis, 4–4.5 μ longis; hyphis atrobrunneis vel pallide brunneis, 1–4 μ diam.; setis atrobrunneis, interdum apicibus minute curvatis, plerumque 4 μ crassis, 13 μ longis.

Fructification similar to that of *Pol. Farlowii* in color and texture but differs in its semiresupinate habit, its possession of dark brown setae, and its slightly smaller spores. *Pol. Farlowii* seems to be western and has not been found on Cephalanthus.

Habitat. — *Cephalanthus occidentalis.*

Distribution. — Illinois, Michigan.

Poria semitincta (Pk.) Cooke, Grevillea, 14:115. 1885

Polyporus semitinctus Peck, 31st Rep. N. Y. State Mus., p. 37. 1879.

Type and important specimen:

Polyporus semitinctus Peck on maple. Griffens, New York. Herb. State Museum, Albany.

Poria semitincta (Pk.) Cooke on maple. Griffens, New York. Herb. New York Botanical Garden, New York.

Fructification annual, separable, effused on wood or bark up to 20 centimeters, usually less, mostly under 1 mm. thick; margin white or with a tinge of lilac, usually 1-3 mm. wide, tomentose or slightly rhizomorphic; subiculum thin, less than 0.3 mm. in thickness, concolorous with margin; tubes less than 0.5 mm.

long; mouths white or with a tinge of lilac that rarely persists in dried specimens, herbarium specimens becoming "ivory yellow" to "cream-buff," subrounded to angular, 2–4, mostly 3 to a mm.; dissepiments entire; basidia 4-spored, 11–26 × 2–5 μ; spores hyaline, oblong, 3–5 × 1–2 μ; hyphae flexuous, branched, 2–6 μ, cross walls very evident, clamp connections present; cystidia rare, usually lacking.

Allied species. — The species can be readily separated from resupinate *Pol. pargamenus* by the spores, which are oblong or short-cylindric, not allantoid. *P. semitincta* is a much thinner plant.

Habitat. — *Acer sp.*, *Betula sp.*, *Castanea dentata*, *Cornus florida*, *Fagus grandifolia*, *Fraxinus sp.*, *Hicoria sp.*, *Nyssa sylvatica*, *Populus sp.*, *Quercus alba*, *Q. imbricaria*, *Q. macrocarpa*, *Q. marilandica*, *Taxus baccata*.

Distribution. — Manitoba, Nova Scotia, Ontario, Illinois, Indiana, Iowa, Kentucky, Maryland, Michigan, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Vermont, Virginia, Wisconsin.

Poria spissa (Schw.) Cooke, Grevillea, 14: 110. 1886

Polyporus spissus Schw. in Fries, Elench. Fung. P., 111. 1828.
Polyporus salmonicolor Berk. & Curt., Hook. Journ. Bot., 1: 104. 1849; Grevillea, 1: 53. 1872.
Polyporus cruentatus Mont., Ann. Sci. Nat., 1: 129. 1854.
Polyporus lactificus Peck, Ann. Rep. N. Y. State Mus., 38: 91. 1885.
Poria crocipora Cooke, Grevillea, 14: 110. 1886.
Poria phlebiaeformis Berk.; Cooke, Grevillea, 15: 24. 1886.

Type and important specimens:

Polyporus spissus Schw., Salem. Herb. of Schweinitz, Philadelphia Academy of Natural Science, Philadelphia.
Polyporus cruentatus Mont., fragment ex herb. Mont. Herb. New York Botanical Garden, New York.
Polyporus lactificus Peck, South Ballston, New York. Chas. H. Peck. Herb. New York State Museum, Albany.

Fructification annual, separable when fresh, inseparable when dry, 20 cm. long or more, 1–5 mm. thick when fresh, 0.5–2 mm. thick in dried specimens; margin tomentose, sterile, 7 mm. wide, "warm buff" to "light pinkish cinnamon"; subiculum conspicuous, but less than 0.3 mm. thick, "light pinkish cinnamon" and tending to disappear in old specimens; tubes 0.5–2 mm. long when fresh, mostly less than 1 mm. long in dried specimens; mouths "capucine yellow," "orange-cinnamon" to "Mars

orange" when fresh, upon bruising or drying changing to "hazel," "liver brown" to "chestnut-brown," or "seal brown"; dissepiments thick-walled, entire, circular to angular, 4–6 to a mm.; spores smooth, hyaline, allantoid, (3.5) 4.5 × 1–1.5 μ; irregularly shaped crystals or oil-like bodies frequently found in sections showing hymenous, tramal hyphae which are branched, 2–4 μ in diameter, frequently encrusted, no clamp connections.

Allied species. — Dried specimens of *Poria spissa* may be confused with those of *P. mutans* Pk., *P. mutans* var. *tenuis* Pk., and *P. purpurea*. *P. mutans* is hard and bony when dried, whereas *P. spissa*, *P. mutans* var. *tenuis*, and *P. purpurea* are too thin to appear bony in texture. Furthermore, the spores of *P. mutans* are ellipsoidal or nearly globose or ovoid, 3.5–5 × 2.5 μ, whereas those of *P. spissa* are 4–5 × 1 μ. *P. spissa* may be separated from *P. mutans* var. *tenuis* by the short tubes (0.5 mm. long) of the latter and the generally darker color of dried plants of *P. spissa*. The spore character will distinguish *P. purpurea* from *P. spissa*, for the spores of *P. purpurea* are 6–9 × 2–2.5 μ, but those of *P. spissa* are smaller, 4–5 × 1 μ.

Habitat. — *Acer rubrum*, *Alnus rubra*, *Castanea dentata*, *Cercis canadensis*, *Fagus sp.*, *Fraxinus biltmoreana*, *F. nigra*, *Hicoria sp.*, *Juglans cinerea*, *J. nigra*, *Liriodendron tulipifera*, *Malus pumila*, *Pinus ponderosa*, *P. radiata*, *Prunus americana*, *Quercus alba*, *Q. borealis maxima*, *Sassafras variifolium*, *Sequoia sempervirens*, *Tilia glabra*, *Tsuga canadensis*, *Ulmus americana*.

Distribution. — Ontario, Alabama, Arizona, California, District of Columbia, Delaware, Illinois, Indiana, Iowa, Kentucky, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, New Jersey, New York, North Carolina, Ohio, Oregon, Pennsylvania, South Dakota, Tennessee, Virginia, West Virginia, Wisconsin.

Remarks. — *P. spissa* is more abundant in the East and in the region of the Great Lakes than in the West. I have never seen it in Alaska, the Yukon Territory, or in the Mackenzie River District of the Northwest Territories. It rarely occurs in the West. Shope (11) reported it from Colorado on conifers, basing the statement upon Kauffman's collections made at Tolland. This record cannot be authenticated according to specimens in the University of Michigan Herbarium. These plants were misdetermined by Kauffman.

Poria mollusca (Pers.) Bres., Hym. Kmet., n. 77; Fungi polon., p. 73

(Plates V–VI)

Important specimens:

Poria mollusca Bres., Femsjo, 1910. Herb. Mycolog. Lars Romell, Stockholm.
Poria mollusca, 1922. Herb. Mycolog. Lars Romell 12797, Stockholm.
Poria mollusca Pers. 38. Eichler. Herb. of Bresadola, Stockholm.
Physisporus molluscus (Fr.) ex Herb. of Karst. Herb. of Bresadola, Stockholm.
Poria arachnoidea Murr. on oak, St. Martinsville, Louisiana, 1897. A. B. Langlois 2556 Herb New York Botanical Garden.

Fructification annual, effused on bark in irregular patches for 20 cm. or more, white, whitish, or yellowish in age, 0.5–1.5 mm., mostly less than 1 mm. thick, somewhat fibrillose or even rhizomorphic; margin white to "ivory yellow," up to 1.5 cm. wide or more, usually less than 1 cm., fibrillose even to rhizomorphic at times; subiculum mostly less than 0.5 mm. wide and often practically invisible, white to "ivory yellow"; tubes white to "Naples yellow," mostly 0.5–1.0 but up to 2 mm. long; mouths white, whitish, or "Naples yellow" to "ochraceous buff" when dry, 3–4 to a mm., subrounded to angular; dissepiments thin, entire; basidia 2–4-spored, 7–15 × 3–4.5 μ; spores subglobose, 2.5–3 (4) × 2–2.5 μ, 1–2-guttulate or granulate; hyphae 3–6, mostly 3 μ wide, occasionally encrusted, seldom septate, often much branched, clamp connections present.

Allied species. — There has always been an uncertainty about plants named "mollusca." This has, however, been due largely to a question of nomenclature rather than to difficulties in distinguishing the plants. Many collections have been called "mollusca" of Fries or Persoon. These have been variously interpreted as *Poria mucida*, *P. vaporaria*, and *P. Vaillantii* by students.

The name "mollusca" is used here for the soft white plant so interpreted by Bresadola for this species of Persoon. This designation was followed by Romell. It is the *Poria mollusca* of contemporary Swedish scholars. Although usually a thin, fragile plant, thick specimens may actually dry to coriaceous in texture and even become felty.

This *P. mollusca*, as defined here, might be confused macroscopically with *P. vulgaris*, but the spores of the two plants are very different. The spores of *P. vulgaris* are allantoid and

measure 4–6 × 1–1.5 μ, whereas those of *P. mollusca* are subglobose, 2.5–3 (4) × 2–2.5 (3) μ.

P. semitincta Pk. may be confused with *P. mollusca*, particularly if Peck's plant is found in the dried state in either the field or the herbarium. The spores of *P. semitincta* are short-cylindric, 3–4 × 1–2 μ. *P. mollusca* does not exhibit tinges of lilac as do fresh plants of *P. semitincta*.

Of the described species from America *P. arachnoidea* Murr. suggests *P. mollusca* most closely. The spores of *P. arachnoidea* are not given in the original description (7). I have examined the type, but did not obtain satisfactory spore material. Clamp connections are present in both plants.

Habitat. — *Acer sp.*, *Alnus tenuifolia*, *Magnolia Fraseri*, *Picea glauca*, *Pinus echinata*, *P. monticola*, *Populus tremuloides*, *P. trichocarpa*, *Tsuga heterophylla*.

Distribution. — British Columbia, Yukon Territory, Alaska, Arkansas, Florida, Idaho, Ohio, Virginia.

Remarks. — *P. mollusca* undoubtedly has a larger distribution than the records indicate. Many plants found in different herbaria under the name are not listed, since their authenticity is doubtful.

Polyporus stereoides Fr. *sensu* Romell

(Plate VII)

Polyporus planus Pk. Ann. Rep. N. Y. State Museum, 31 : 37. 1879; non *P. planus* Wallr. 1833.
Trametes stereoides var. Kemetii Bres.
Trametes stereoides (Fr.) Bres. Hymen. de France, 596.
Coriolus planellus Murrill, Bull. Torr. Bot. Club, 32 : 649. 1906.
Polyporus planellus (Murr.) Overh., Wash. Univ. Studies, 3 : 29. 1915.

Important specimens:

Pol. stereoides, Jebrenjokk, Sweden. Herb. Mycolog. Lars Romell, Stockholm.
Pol. stereoides on *Thuja plicata*, Rockhill, Montana. Herb. Mycolog. Lars Romell, Stockholm, ex Herb. James R. Weir 12055, det. Lars Romell.
Trametes stereoides (Fr.) Bres. "typica" = *Trametes mollis* (Somm.) Fr. = *Pol. stereoides* Fr. cum typo comparatus! Mustiala, 1896. Karsten. Herb. of Bresadola, Stockholm.
Pol. stereoides Fr. *sensu* Romell on *Betula alaskana*, Koyukuk, Alaska, 1936. Coll. and det. Dow V. Baxter. Herb. Dow V. Baxter, Ann Arbor.
Pol. stereoides, Fort Wrigley, Northwest Territories, 1937. Coll. and det. Dow V. Baxter. Herb. Dow V. Baxter, Ann Arbor.

Fructification annual or reviving as in the genus Polystictus or

Trametes, coriaceous, sessile, effuse-reflexed or entirely resupinate; pileus solitary, flabelliform, 25 × 15 × 0.3–9.5 mm., surface concentrically furrowed and zonate hirsute, "tawny-olive," "Saccardo's umber," to "light seal brown"; margin thin, entire or undulate, finely tomentose, sterile below, context "cartridge buff," mostly less than 0.3 mm. thick; resupinate specimens appearing in orbicular patches, 3.5 × 2.5 cm., margin "cartridge buff" to "tawny-olive," up to 1 mm. wide, pubescent, context "cartridge buff," less than 0.3 mm. wide; tubes 0.3–1 mm. long, "avellaneous" to "Saccardo's umber"; mouths angular, 4–5, mostly 4 to a mm.; basidia large, 15–21 × 5.5–8 μ; spores hyaline, 7–12 × 3.5–5.5 μ; hyphae 1–3 μ, mostly nonseptate.

Habitat. — *Acer sp.*, *Betula neoalaskana*, *B. papyrifera occidentalis*, *Corylus rostrata*, *Hicoria alba*, *Populus trichocarpa*, *Quercus sp.* Also known in Europe on *Salix sp.* and Sorbus.

Distribution. — Northwest Territories, Alaska, California, Iowa, Maine, Missouri, New Hampshire, New York, Vermont, Wisconsin.

Remarks. — The description presented is based upon specimens which were studied by Romell. Romell (9) remarks that the name "is well adapted as the habit very much resembles a Stereum." His collections agree "exactly with a specimen from Femsjö in the herb. of Fries so named. The label is written by Rob. Fries, and Elias Fries probably suggested the name or at least approved it, so that the specimen can be held authentic." He calls attention to the fact that the statement "ad truncos abiegnos," which may be correct, is more probably a mistake, since no one else has found this plant on conifers. Romell states further in regard to the Friesian plants that there is another supposedly authentic specimen (with a label written by Elias Fries himself), but that this belongs to *Polyporus cervinus* Pers. (*Daedalea mollis* Somm., *Trametes mollis* Fr.), "a species which is really closely allied, though in my opinion specifically distinct as it is much thicker and has pores more than twice as large and consequently a different habit . . . *Pol. stereoides* being a very rare plant in other parts of Sweden . . . Fries probably found it but once. It is thus no wonder that he later forgot the habit and characters of it and confounded it with specimens of the allied *Trametes mollis*. That his idea of *Pol. stereoides* was not clear in his later age appears also from the fact that he did not recognize the specimen

of this plant sent from Blytt and mentioned in Hym. Eur. under *P. macraulos.*"

Pol. stereoides is uncommon elsewhere than in Sweden, for it is rare in North America. Furthermore, it does not occur abundantly where I have found it. The collections from Koyukuk, Alaska, and from Fort Wrigley, Northwest Territories, are identical with the plants observed in northern Europe.

Poria purpurea (Fr.) Cooke, Grevillea, 14 : 112. 1886

Polyporus purpurea Fr., Syst. Myc., 1 : 379. 1821.
Poria aurantio-carnescens P. Henn. Abhandlungen S. Bol. Ver. Brand 40, p. 125. 1898.
Polyporus brunneus Pers. ex Romell. 1926.
Polyporus oxydatus Berk. & Curt., Journ. Linn. Soc. Bot., 10 : 317. 1868.
Polyporus purpureo-rufus of von Post. ex Romell. 1926.
Poria Bresadolae Bourdot & Galz., Hym. de Fr., n. 690. 1909.

Type, cotypes, and important specimens:
Poria aurantio-carnescens P. Henn. (Orig. Ex.) comm. P. Henn. Herb of Bresadola, Stockholm.
Polyporus oxydatus Berk. & Curt., S. C. Kew. Fragment of Type. Herb. New York Botanical Garden, New York.
Poria Bresadolae on *Pinus silvestris*, leg. Galzin, 1911. Ex Herb. H. Bourdot n. 8197. Herb. of Bresadola, Stockholm.
Poria purpurea var. *roseo-lilacina* on Betula. From Eichler. Herb. of Bresadola, Stockholm.

Fructification in patches usually not more than 10 cm. wide, inseparable, thin, 0.5–1.5 mm. thick; margin whitish at first, yellowish and finally "fawn color," arachnoid and remaining so or becoming fertile in age; subiculum "fawn color" to "bone brown," very thin, less than 0.5 mm. thick; tubes meruloid, becoming 0.5–1.5 mm. long; mouths circular to angular, unequal, 2–5, mostly 2–3 to a mm., at first yellow-luteo-fulvous (Romell), then "sorghum brown," "Hays brown" to "light seal brown"; basidia hyaline, clavate, 12–15 × 5 μ; spored, spores cylindrical or allantoid, often 2-guttulate, 5–8 (6–7 × 2) 2–2.5 μ; hyphae of the trama hyaline to light brown, encrusted, varying widely in diameter, 2–10 μ; no cystidia present.

Allied species. — *Poria purpurea* is allied to *P. spissa*, and specimens might be mistaken for young stages of this ally. Both are yellow when young and both turn reddish purple in age. The spores are similar in shape, but are longer in *P. purpurea*, i.e. 5–8 μ, whereas

in *P. spissa* they are 4 5 μ. In *P. spissa* they are usually 1 μ wide, but in *P. purpurea* they average 2 2.5 μ. The tubes are not stratified in *P. purpurea*. The mouths in *P. purpurea* are mostly 2 3 to a mm., whereas in *P. spissa* they are 4-6 to a mm. *P. purpurea* is ordinarily a much thinner plant than *P. spissa*.

P. purpurea differs from *P. mutans* Peck since the spores in that species are broadly ellipsoidal or nearly globose, i.e. 3.5–5 × 2.5 μ. In the variety "tenuis" of *P. mutans*, the mouths and subiculum are uniformly yellowish and change where bruised or in drying to dull red.

P. violacea Fr., according to a specimen on pine in the Bresadola Herbarium, from Eichler (and I am inclined to believe that this collection is probably as nearly representative of the contemporary concept of this plant as any), seems to be a young form of *Pol. abietinus*. The color is actually the same, although the plant is thinner. The spores are 5 × 2.5 3 μ. The "pale mouse gray" of the margin gives the plant a general violet color instead of the "benzo brown" of the tubes. There are 2 3 mouths to a mm.

The variety of *P. purpurea*, *P. purpurea roseo-lilacina* Bres., is "fawn color," and this color distinction is the one character that separates it from the species. The margin is "tilleul buff." It is significant that the plant is not necessarily as thin, nor is it "onion-skin pink," as is *Poria mutans tenuis*. This variety, *P. purpurea roseo-lilacina*, is very common on aspen in the Rocky Mountain forests of northwest America.

Habitat. — *Acer rubrum*, *A. macrophyllum*, *Fagus grandifolia*, *Hicoria sp.*, *Picea glauca*, *Pinus contorta*, *P. monticola*, *P. Jeffreyi*, *Platanus racemosa*, *Populus tremuloides*, *P. trichocarpa*, *Pseudotsuga taxifolia*, *Umbellularia californica*.

Distribution. — Alberta, Manitoba, Ontario, Yukon Territory, Alabama, California, Colorado, Idaho, Indiana, Kansas, Kentucky, Michigan, Nebraska, Nevada, New York, North Carolina, Ohio, Oregon, Pennsylvania, South Carolina, Tennessee, Washington, West Virginia, Wisconsin.

Occurrence. — *P. purpurea* is found chiefly on hardwood logs or dead standing timber throughout the United States and it often occurs beneath the bark on fire-killed trees. It also appears, less commonly, on coniferous timber. The variety, *P. purpurea roseo-lilacina*, occurs so abundantly on aspen in the Jasper National

Park country of Alberta that it is to be regarded as one of the most common resupinates of the region. It is also one of the few polypores known from Nevada.

Remarks. — Apparently *P. Bresadolae* is found on conifers, but I can see no significant difference between that species and *P. purpurea.* The spores are the same, the color and size of the mouths of the two plants are similar. The mouths in *P. purpurea* are 3–4 to a mm.; in *P. Bresadolae*, mostly 3 to a mm. The thickness of the plants and the internal structures are the same.

Perhaps few species in the colored group of porias have had more interpretations than *P. purpurea.* Bresadola even confused *P. spissa* with it: a plant from Missouri on *Prunus americana* was so labeled in the Bresadola Herbarium in Stockholm.

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Poria tacamahacae, sp. nov., on *Populus balsamifera*, Athabasca River, vicinity of Waterways, Alberta, Canada

FIG. 1. *Polyporus fragilis* Fr. from von Post painting, Stockholm

FIG. 2. *Polyporus viridans* on Salix? Saltsjö near Stockholm. Det. L. Romell

FIG. 1

FIG. 2

Polyporus viridans Berk. & Br. Staunton Notts, 1860; Herb. Berk., 1879; Royal Gardens Kew. Upper figure, × 1½; lower figure, × 4

FIG. 1. *Polyporus Farlowii* on *Schinus mollis*, Phoenix, Arizona. Coll. W. H. Long

FIG. 2. *Polyporus illinoisensis* on *Cephalanthus occidentalis*, Vandalia, Illinois

Poria mollusca on *Picea glauca*, Burnt Island, Great Slave Lake, Northwest Territories

Fig. 1. *Poria mollusca* (Pers.) Bres., Drottningholm, Stockholm. Coll. and det. Dow V. Baxter

Fig. 2. *Polyporus molluscus* det. Romell; *Poria mollusca* Pers. sensu Bres., det. Lundell, on Sorbus, Stockholm

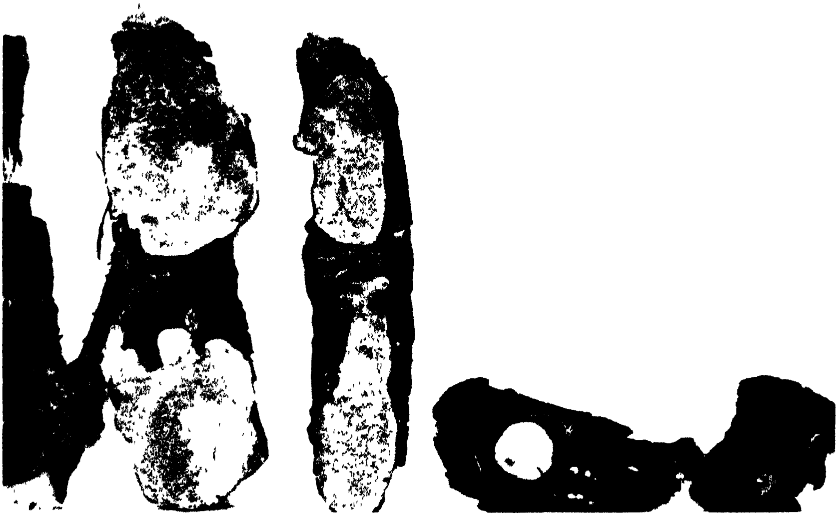

FIG. 1. *Polyporus stereoides*, Stockholm

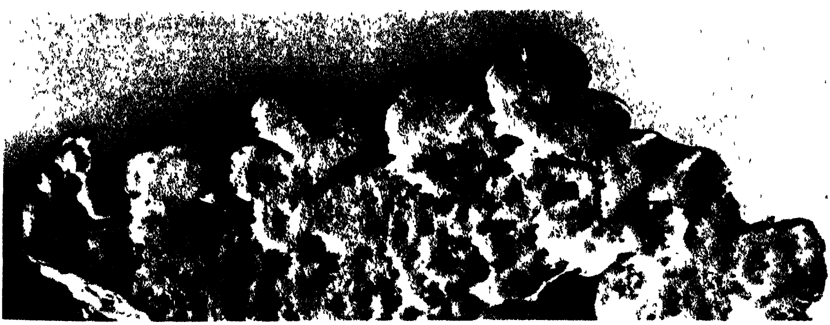

FIG. 2. *Polyporus stereoides* Fr. on *Betula neoalaskana*, Koyukuk, Alaska

POLYPORUS ELLISIANUS (MURR.) SACC. & TROTT AND *POLYPORUS ANCEPS* PK. IN CULTURE: A STUDY OF ISOLATES FROM WIDELY SEPARATED FOREST REGIONS

DOW V. BAXTER AND WALLACE E. MANIS

THE timber-sale policies of the United States Forest Service in regard to forest sanitation recognize a need for protecting future timber crops from wood-destroying and other fungi. Over large southwestern areas the *Pinus ponderosa* forest type prevails, and here the cull scale in logging operations alone is between 10 and 15 per cent of the total cut (7).

The western red rot (3), which has been attributed to *Polyporus Ellisianus* (Murr.) Sacc. & Trott, is one of the most common rots of the *ponderosa* pine and, in the Southwest at least, causes more decay than does *Fomes pini*, which is so prevalent on western conifers elsewhere.

This "*Pol. Ellisianus*" [1] usually fruits on prostrate logs and apparently much less abundantly on down timbers which are off the ground (Pl. I). *Pol. anceps* Pk., also, is widely distributed throughout the West (and East) on various coniferous woods, but generally no serious losses in standing timber have been attributed to it in the East. This fungus fruits on fallen logs and is usually found on high stumps and standing snags (Pl. II). It is frequent on black spruce stumps in the muskegs near Fort Wrigley, Northwest Territories, and is found so commonly there that its abundance suggests the habit of occurrence of "*Pol. Ellisianus*" in the Southwest.

The two fungi have been considered synonymous by various investigators. It is at best so difficult to separate them that the

[1] Quotation marks around the name *Pol. Ellisianus* denote field determination based largely upon the habit of growth. It is doubtful if such a distinction will prove to be real.

desirability and need for comparing plants which have been collected from widely separated forest localities are evident.

This paper reports the results of a study of numerous collections of *Pol. anceps* by the late C. H. Kauffman, and of those made in Arizona, New Mexico, California, South Dakota, and the Northwest Territories by the senior author. Cultures were obtained from the southwestern forms and compared with others secured from specimens collected during the field season of 1937 near the Arctic Circle, Fort Wrigley, Northwest Territories. Cultures have also been furnished by the Forest Products Laboratory, Madison, Wisconsin, and by the Division of Forest Pathology at Albuquerque, New Mexico.[2]

THE IDENTITY OF *POLYPORUS ANCEPS* PK.

Kauffman (4) calls attention to the fact that *Pol. anceps* is one of the least known among the white polypores described by Peck, "partly because of . . . rarity," and partly because it has been thrown into synonymy by recent students of the Polyporaceae. It is not mentioned at all in some of the widely used keys to the genus.

Under the name *Tyromyces anceps* (Pk.) Murr., Murrill (6) describes the spores as "globose, smooth, hyaline, 5 μ." These terms suggest those given by the same investigator for *T. Ellisianus* Murr., a plant collected by J. B. Ellis at Newfield, New Jersey, on a dead pine trunk. Murrill describes the spores of this species as "globose, smooth, hyaline, 4 μ." The heart rot in western yellow pine in the Southwest has been attributed to *Pol. Ellisianus* (Murr.) Sacc. & Trott. According to Boyce (2), Weir and, later, Hubert (3) consider this fungus described as having globose spores to be synonymous with *Pol. anceps* Pk. Since Kauffman found the spores of *Pol. anceps* to be oblong, 3–3.5 $\times$ 7–8 (9) μ, it was evident that the measurements of a large number of the spores of southwestern plants and of those in collections from other regions must be made, as well as remeasurements of the spores of *Tyromyces Ellisianus*. Spore measurements of plants collected under the names "*Pol. Ellisianus*" and *Pol. anceps* and ranging from the Southwest approximately to the Arctic Circle

[2] Our appreciation is expressed to Dr. C. Audrey Richards, Division of Forest Pathology, Forest Products Laboratory; to Dr. Lake Gill, Division of Forest Pathology, Albuquerque; and to T. R. Moberg of the same Division for furnishing cultures of fungi for study.

TABLE I

SPORE MEASUREMENTS OF *POL. ANCEPS* AND "*POL. ELLISIANUS*" FROM WIDELY DIFFERENT SOURCES

Field name applied	Fungus determined by	Conifer and source of isolation	Location	Spores from fruiting body	Spores from culture
T Ellisianus	Murrill	Dead pine trunk	New Jersey	2–3 × 6–8 μ	. . .
Pol anceps	Baxter	*P glauca*	Fort Wrigley, Northwest Territories	3.5 × 7–8 μ	. . . .
Pol anceps	Baxter	*P glauca*	Fort Wrigley, Northwest Territories	3 5 × 7–9 μ	. . . .
Pol. anceps	Kauffman	Pine	Tennessee	3 × 7–9 μ	. . .
Pol anceps	Kauffman	Tamarack	Michigan	3 × 7–9 μ	.
Pol anceps	Kauffman	*P strobus*	Pennsylvania	3 5 × 7–8 μ	. . . .
Pol anceps	Baxter	*Picea sp*	Michigan	3 × 6 μ	. . . .
"*Pol Ellisianus*" SF1 *	Baxter	*P ponderosa* Fruiting body	Santa Fe National Forest, New Mexico	3 5 × 7 5–9 μ	3 5 × 7–8 μ
Pol anceps 545 *	Hubert	*P glauca* Wood	Forest Products Laboratory	. . .	3 × 9 μ
Pol anceps 547 *	Hubert	*P ponderosa* Wood	Bonner, Montana	. .	3 5 × 7 5-8 μ
Pol. anceps U25 *	Baxter	*P glauca* Fruiting body	Fort Wrigley, Northwest Territories	. .	3 × 6–7 μ
"*Pol Ellisianus*" P2a *	Moberg	*P ponderosa* Center rot	Prescott, Arizona	. . . .	3 × 7–8 μ
"*Pol Ellisianus*" M1a *	Moberg	*P. ponderosa* Branch rot	Mimbres, New Mexico	. . .	3 × 7.5 μ
"*Pol Ellisianus*" 7C4 *	Moberg	*P. ponderosa* Center rot	Black Hills, South Dakota	. . .	3 × 7 5–8 μ
"*Pol Ellisianus*" 9F2 *	Moberg	*P ponderosa* Branch rot	Black Hills, South Dakota	. . .	3 × 7 5 μ

* Identification number of fungus studied in culture.

are presented in Table I. It will be noted that all spores of all specimens collected in the Southwest and of both "*Pol. Ellisianus*" and *Pol. anceps* from other regions of North America correspond to Kauffman's measurements for *Pol. anceps.* The spores of the type collection (*T. Ellisianus*) are not globose, but measure 2-3 × 6–8 μ.

METHOD OF CULTURE

The fungi were cultured on malt agar in standard petri dishes and liter flasks as previously described for other cultures of this nature (1). Autoclaved pine blocks $\frac{5}{8} \times \frac{5}{8} \times 3\frac{1}{4}$ inches were also used.

Water agar was prepared by soaking 25 grams of agar-agar in distilled water for twenty-four hours and changing the water every day for five successive days. This was autoclaved for twenty minutes at fifteen pounds pressure.

A light and a dark series of cultures for each isolate and also a temperature series were set up in the same manner as were those described for a study of other fungi and reported from this laboratory (1).

In order to determine if antagonism existed between the different fungi, a series of plates was so prepared that in each petri dish two of the isolates were matched, and the set was so arranged that each isolate was matched with every other.

SYNOPSIS OF THE GROWTH CHARACTERISTICS OF *POL. ANCEPS* AND "*POL. ELLISIANUS*"

Pol. Ellisianus is known in the field as a "rapidly working rot," and, because of the moisture required, thrives in the sapwood and larger branches, particularly those on the ground. The cultures, both in the light and in the dark, indicate that this is one of the most rapidly growing forms among approximately 140 species now in our laboratory. This same characteristic, however, also features cultures of *Pol. anceps*. In the light and the dark series there was neither a marked difference in growth-rate nor any significant variation in the growth of any of the isolates of either *Pol. anceps* or "*Pol. Ellisianus.*" In the light pore formation appeared in fourteen days in the culture of *Pol. anceps* from the near-Arctic and in the culture from the isolates of this species obtained from the Forest Products Laboratory. Pores were likewise formed in the light in the two isolates of "*Pol. Ellisianus*" obtained from the Black Hills of South Dakota. In the southwestern cultures (those obtained from New Mexico and Arizona) they did not occur within the two weeks. In a longer period in the light such formation takes place in all isolates. Darkness prevented pore formation in all but one isolate,

which came originally from material collected in Montana. Typical basidiospores were produced in the various cultures as recorded in Table I. "*Pol. Ellisianus*" and *Pol. anceps*, when grown on wood blocks, both exhibited a much more luxuriant mycelial growth than when cultured on agar. The chief differences in growth habits for the fungi grown in one-month-old culture on wood blocks and in one-month-old petri-dish culture are the luxuriant development of mycelium and the general lack of pore formation on the wood. These variations are probably due to the larger amount of moisture available in the wood-block cultures.

All isolates produced chlamydospores in both young and old stages of growth. In young cultures on water agar they were very numerous at two days, both terminal and intercallary chlamydospores appearing, the former being the more abundant. They were found in culture of the same age on malt agar, but were less frequent. On both water and malt agar most of them were submerged. Chains of such submerged chlamydospores were found, however, only in the older cultures. (See Fig. 1.)

Typical clamp connections occurred in all the isolates examined. Few septations in the hyphae were noted. The width of the mycelium varied in each culture. Branching was characteristically found at the clamps in almost all the hyphae observed.

With minor exceptions all isolates responded similarly to the temperature studies. All the plates were full in seven days at 30° C., 35° C., and 40° C. except that of "*Pol. Ellisianus*" from the Black Hills at 40° C. The growth of this fungus measured only 17.6 mm. for the seven-day period, but in fourteen days its mycelium filled the dishes in all the tests. In the fourteen-day period, the dishes were also filled at 20° C. and 25° C. There was some variation among the different isolates in the rate of growth at these lower temperatures in a seven-day period, but this dissimilarity was negligible. The most unusual temperature relation was exhibited by *Pol. anceps*, 545, which has a much higher range than any of the other isolates studied. This isolate grew 23.8 mm. during the first week at 45° C. Furthermore, at both 20° C. and 25° C., the average growth-rate was less than that of any of the other fungi in culture. Culture M1a was the only other isolate used in the test which grew at 45° C.

The cross-matching of all three isolates of *Pol. anceps* and all five of "*Pol. Ellisianus*" shows that no two of the dicaryon phases

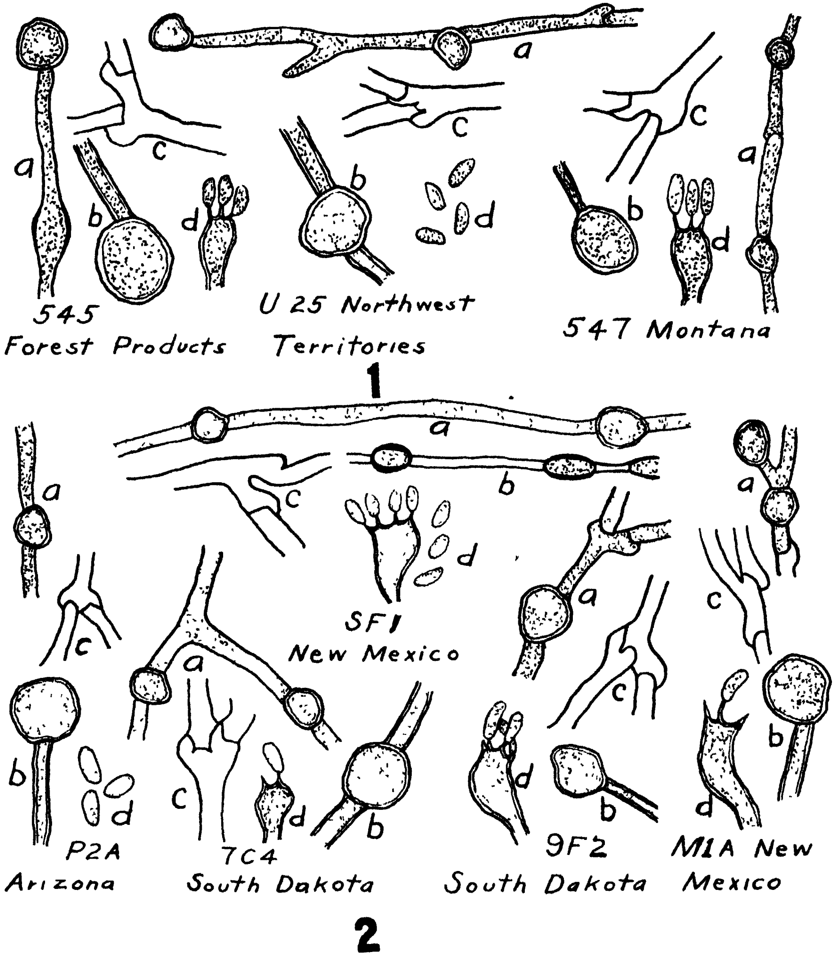

FIG. 1. *Polyporus anceps* FIG. 2. "*Pol. Ellisianus*"

a. Chlamydospores in water-agar cultures
b. Chlamydospores in malt-agar cultures
c. Clamp connections and branching hyphae
d. Basidia and basidiospores

are compatible. Either a distinct line was formed by a massing of hyphae where the two met or a narrow zone of agar into which relatively few hyphae penetrated remained between the two margins.

In addition, the placing of isolates in matched pairs in the same

petri dish shows other variations in the mycelial characteristics. The chief differences are: the meagerness of aerial mycelium in "*Pol. Ellisianus*," 9F2, South Dakota, and *Pol. anceps*, 547, Montana, as contrasted with its abundance in all the other cultures, and also the greater amount of pore formation in "*Pol. Ellisianus*," 9F2, South Dakota, *Pol. anceps*, 545, Forest Products Laboratory, and *Pol. anceps*, 547, Montana, than in the remaining isolates. On the other hand, all the cultures from different geographical regions exhibited approximately an equal rate of growth. These characteristics are illustrated in Plate III.

CONCLUSION

The numerous variations exhibited in cultures of the eight isolates of these two fungi, referred to in the literature under two species names, point to the fact that different races or strains exist, even though the fungi may come from the same region. These differences are as great as any morphological distinctions that can be determined from the fragmentary type material of *Pol. Ellisianus* of Murrill and the known *Pol. anceps* of Peck. For the present and until the writers have had an opportunity to restudy the type material further, it is believed that the known morphological distinctions (largely in habit of growth) are not great enough to separate the two as species.

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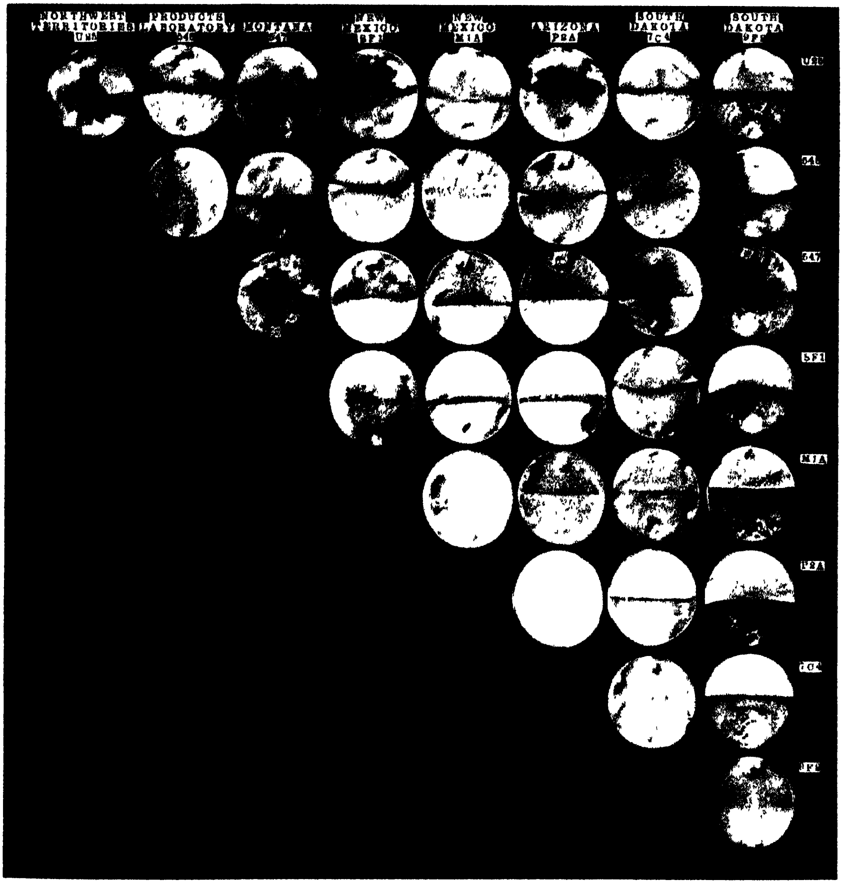
PLATES I–III

"*Polyporus Ellisianus*" on *Pinus ponderosa*, Santa Fe National Forest, New Mexico, July, 1937. Coll. D. V. Baxter

Polyporus anceps on *Picea glauca*, Fort Wrigley, Northwest Territories, Sept. 12, 1937. Coll. and det. D. V. Baxter



Matched geographical isolates of *Polyporus anceps* and "*Pol. Ellisianus*"

PRACTICAL CUTTING METHODS FOR NORTHERN HARDWOODS

FRANCIS H. EYRE AND JOHN R. NEETZEL

IMPORTANCE OF THE NORTHERN HARDWOOD FOREST

IT HAS been five decades since the heyday of lumbering in Michigan, and at present vast areas which once were saw-timber forests are covered by reproduction and second growth of one kind or another. Yet even now such part of the original lumber industry of the state as remains is not dependent on second growth, but is still largely engaged in cutting old-growth forest. There are at the present time in Michigan nearly two million acres of old-growth saw timber, which make up about 10 per cent of the total forest land area of the state (1). This timber is 85 per cent hardwood and hemlock. Any immediate hope for permanent sustained-yield forestry in Michigan is bound up, therefore, in the fate of the northern hardwood forest.

The perpetuation of the lumber industry of Michigan is dependent on the prolongation of the life of this old-growth forest until second growth can come to merchantable size. Before such an aim can be achieved and permanent forestry put into effect, it is necessary to work out rational cutting methods, and these in turn must have wide application in the management of forest properties.

Foresters and timberland owners should be interested, therefore, in the timber-cutting investigations of the Lake States Forest Experiment Station carried out in coöperation with the Cleveland Cliffs Iron Company at Dukes in the Upper Peninsula of Michigan. It is the purpose of this paper to point out some of the conclusions that can be drawn from ten years' experience in conducting cutting experiments in the old-growth northern hardwood forest type.

THE NORTHERN HARDWOODS

Extent

The northern hardwood forest of the Lake States originally covered a far greater area than it does at present. In pioneer times it

extended from southeastern Michigan to central Minnesota. Today the type is very much restricted. Since hardwoods occur on the better soils, large areas have been converted into farm lands. This is especially true in the southern part of the region, where climatic conditions are more favorable for agriculture. Additional large areas have been cut and burned and are now in various stages of regeneration, so that the present commercial forest is confined almost entirely to the Upper Peninsula of Michigan and to northern Wisconsin.

Composition

A variety of species, mostly those tolerant of shade, normally composes the northern hardwood forest, among them, sugar maple, yellow birch, hemlock, beech, basswood, and American elm, to mention only the more important. The proportion of each species changes somewhat from place to place (2). In the western part of the Upper Peninsula basswood makes up 2 per cent of the stand; in the Lower Peninsula, 8 per cent; and in Minnesota, 38 per cent. Yellow birch shows the opposite trend, with 12 per cent in the Upper Peninsula, 1 per cent in the Lower Peninsula, and almost none in Minnesota. There is also more hemlock in upper Michigan; in Minnesota this species is almost absent. Beech is prominent in the Lower Peninsula and in the eastern part of the Upper Peninsula, but of relatively little importance farther west. Sugar maple, however, is well represented throughout the complete range of the northern hardwoods and is the predominant tree of the type.

Condition

The forest is old — 200 years and upward — and silviculturally overmature. Despite the fact that many areas were lightly culled for white pine, elm, and basswood years ago, it is essentially virgin. Consequently there is much growth-stagnant and defective timber within the type.

Volumes and Size Classes

Timber volumes usually range from 6 to 14 thousand feet per acre, depending on stocking, site quality, and amount of defect. Although individual trees of some species up to 36 inches in diameter are commonly found, with occasional trees of yellow birch or hemlock up to 4 feet, the average tree is about 18 inches in diameter. There is also a fair representation of trees in the smaller classes

(Table I), and almost everywhere a good stocking of hardwood seedlings is growing under the canopy of the older trees. By far the greater part of this undergrowth is sugar maple, a species extremely tolerant of shade.

The character of the hardwood forest is perhaps best illustrated

TABLE I

DISTRIBUTION OF TREE-DIAMETER CLASSES IN AN UPPER PENINSULA FOREST OF NORTHERN HARDWOODS *

(Based on 240 acres)

D.B.H. (*Inches*)	*Number of trees per acre*	*Basal area per acre* (*Sq. ft.*)
5	17.3	2.353
6	13.4	2.626
7	10.6	2.830
8	8.7	3.036
9	8.1	3.580
10	7.3	3.978
11	7.0	4.620
12	6.9	5.416
13	6.4	5.901
14	6.5	6.948
15	5.8	7.117
16	5.8	8.097
17	5.0	7.880
18	4.7	8.305
19	4.2	8.270
20	3.6	7.855
21	2.9	6.974
22	2.7	7.128
23	2.3	6.636
24	1.9	5.970
25	1.7	5.797
26	1.3	4.797
27	1.0	3.980
28	0.7	2.996
29	0.6	2.754
30	0.5	2.455
31	0.4	2.096
32	0.2	1.118
33	0.2	1.188
34	0.1	0.630
35	0.1	0.668
36	0.1	0.707
	138.0	144.706

* Data from the Upper Peninsula Experimental Forest, Dukes, Marquette County, Michigan.

by a delineation of the basal-area distribution by diameter classes. Figure 1 gives this for three different stands, one each in Marquette County, Michigan, Ontonagon County, Michigan, and Shawano County, Wisconsin. It is indeed surprising to see the close similarity of the hardwood forest in widely separated localities. Thus it may be concluded that principles of silviculture worked out in one locality

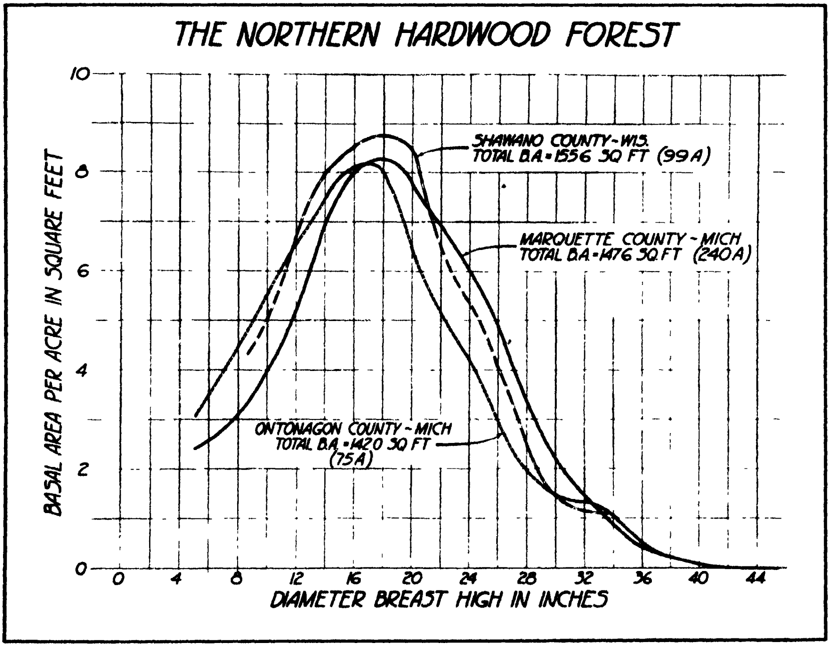


FIG. 1. Stocking in basal area per acre by diameter classes of typical stands of northern hardwoods

have application elsewhere in the northern hardwood forest region, despite the variations in species and site that are almost certain to occur.

CUTTING METHODS

How should northern hardwoods be cut in order to get satisfactory reproduction and growth? The possibilities are many, and quite a number of methods have been tried, from absolute clear-cutting to a very light selection, with variations such as improvement cuttings and group selection. But for the sake of simplification

and because complete records are available for a ten-year period, the discussion will be limited to a description of three experimental cuttings:

1. A light cutting (19 acres), in which 29 per cent of the merchantable saw timber was cut. Since the cut was restricted mostly

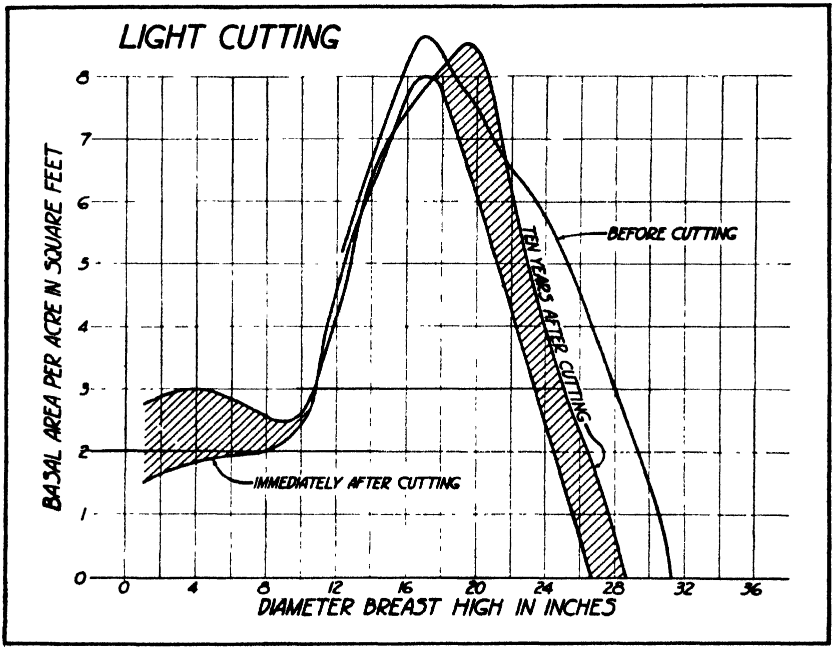


FIG. 2. Growth in basal area by diameter classes after a light selective cutting

to trees over 22 inches in diameter, only 24 per cent of the basal area was removed.

2. A moderate cutting (10 acres), in which a definite effort was made to eliminate growth-stagnant and defective trees irrespective of size. It resulted in the removal of 62 per cent of the saw-log volume and 56 per cent of the basal area.

3. A heavy or "commercial" logging (5 acres), which resulted in the removal of about 90 per cent of the saw-timber volume, but only 81 per cent of the basal area.

Before any felling was undertaken, the stand cut lightly had a net volume of approximately 10,400 feet B.M.; the stand cut moderately, 9,200 feet B.M.; and the stand cut heavily, 10,400 feet B.M.

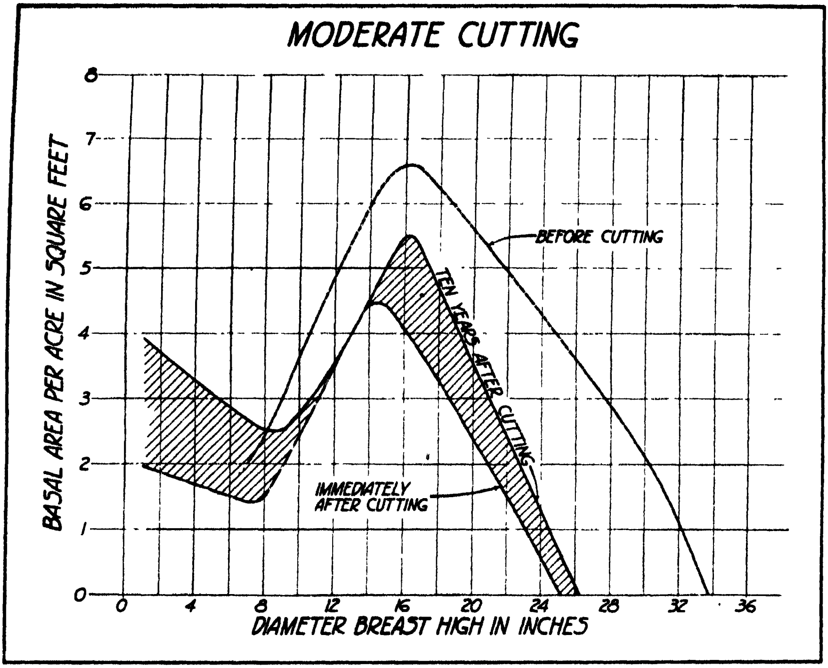


FIG. 3. Growth in basal area by diameter classes after a moderate selective cutting

A graphic picture of the effect of these three cuttings in reducing the stand is given in Figures 2–4. These cuttings, differing considerably in degree, encompass the range of practical possibilities in silviculture.

SILVICULTURAL RESULTS

All three cuttings have been under observation for ten years, and the results of reproduction studies and growth measurements are now available.

Reproduction

On all areas reproduction has been adequate. In fact, seedlings in the form of advance growth were present in large numbers before cutting. As stated in an earlier paper by the authors (3), ". . . a

study of advance reproduction on a representative area indicated the presence of 24,700 seedlings per acre over one year old and less than one and one-half inches in diameter." Although many seedlings were

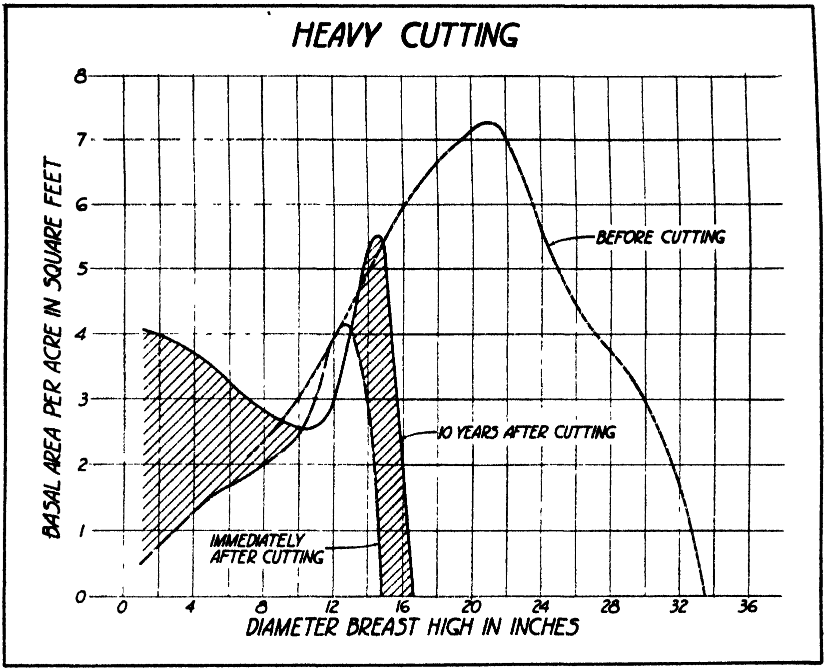


FIG. 4. Growth in basal area by diameter classes after a heavy cutting

cut off in the process of logging, they quickly sprouted back. Sugar maple, prominent in the original stand, was still strongly represented in the reproduction following cutting on the several areas. The obtaining of satisfactory regeneration does not seem, therefore, to be a difficult problem.

Growth

Growth of the residual stand after cutting varied markedly under the several methods of treatment.

In basal area:

Increment in cubic feet is, perhaps, the best criterion of the vigor of a stand. For small trees, however, it is difficult to calculate such growth. Consequently basal-area growth or the growth of the cross

section of the whole stand at breast height ($4\frac{1}{2}$ feet above ground) has been used to picture what happened to the stand (Figs. 2–4). Basal-area growth for the ten years was greatest on the moderate cutting (24 square feet), intermediate on the light cutting (21 square feet), and least (18 square feet) on the heavy cutting. All stands thus showed a reasonable degree of vigor.

In board feet:

When volume was expressed in terms of board feet, however, the order was changed (Table II). The light cutting resulted in the

TABLE II

NET INCREMENT PER ACRE PER YEAR FOR THREE EXPERIMENTAL CUTTINGS IN NORTHERN HARDWOODS

Method	First 5 years	Second 5 years	Average for 10 years	
	Board feet	Board feet	Board feet	Percentage
Light cutting .	245	206	226	2.0
Moderate cutting	165	211	188	3.6
Heavy cutting .	98	98	98	5.9

best growth (226 board feet per acre per year); the moderate cutting was second, with 188 board feet; and again the heavy cutting was last, with only 98 board feet per acre per year. The growth determinations when separated for two five-year periods indicate that there has been a slowing down in the rate of growth of the area cut lightly, whereas that of the moderate cutting has more than held its own. The growth rate of the heavily cut area remained constant for both periods.

By size of tree:

A consideration of the growth by size of tree is most enlightening. In the light cutting it can be seen from Figures 2–4 that the growth of the stand was almost all on large trees, with some growth of saplings; in the moderate cutting the increment was distributed among trees of a wider range in diameter; in the heavy cutting the growth of reproduction and saplings was greatest of all, but the increment in board feet was limited to the smaller trees — those under 16 inches in diameter.

In quality:

The facts here presented are of decided importance in terms of quality growth. On the basis of extensive mill-scale studies carried on a number of years ago a relationship between diameter of tree and value of the lumber per M feet has been carefully derived (4). This work indicated a negative value for trees under 12 inches in diameter, a positive value for 12-inch trees, and progressively higher values for trees up to 25 inches. When these figures were applied to trees 12 inches in size and larger, the growth per acre per year was computed to be worth $4.25 for the light cutting, $2.67 for the moderate cutting, and $0.68 for the heavy cutting. The differences are further accentuated by the fact that the value given for the heavy cutting is scarcely realizable, since the stand is too light to warrant returning for a second cut within a reasonable period. One may admit that these figures may be somewhat changed today, but it is perfectly clear that the light cutting has given much the best results in quality growth.

The rate of value increase during the past decade is also of interest. As trees increase in diameter there is an automatic increase in value. This is brought out by a comparison of the percentage growth in board feet as compared with that in dollars and cents. Although the increment in board feet was at the rate of 2 per cent per annum for the light cutting, 3.6 per cent for the moderate cutting, and 5.9 per cent for the heavy cutting, in terms of value these figures were "stepped up" to 3.2 and 5.5 per cent for the light and moderate cuttings, respectively, but for the heavy cutting there was no realizable saw-log value.

PRACTICAL SIGNIFICANCE OF RESULTS IN MANAGEMENT

It is generally recognized that before scientific forest practice can be put into effect on any property, a sound system of silviculture and a determination of expected growth must be worked out. These findings must in turn be fitted into the business structure of the property itself.

Silvicultural Methods

The experiments described bring out the silvicultural possibilities of northern hardwoods. The reaction to cutting has been most gratifying. Such a forest is truly remarkable in its power to recuperate from cutting. Reproduction is not difficult to obtain but,

what is more important, it is evident that considerable latitude may be employed in the choice of a cutting method, particularly with regard to the degree of cutting. As already shown, very satisfactory results have been obtained with light and moderate selection cuttings. Even with a heavy cutting the productivity of the land, provided fire has been kept out, is not destroyed, and the young growth of saplings is exceptionally vigorous.

Cutting Cycle

From the point of view of sustained-yield management the figures presented have considerable direct use. On the lightly cut area it should be possible to return in fifteen or twenty years for a second cut of approximately the same amount as the original; in twenty-five or thirty years on the medium cutting; but it would require at least eighty years, probably longer, to build up a good stand on the heavily cut tract.

In order to determine the proper cutting cycle thought must also be given to the early retirement of a part of the investment in timber and improvements. How much to retire depends on the circumstances of the individual owner and the method of transportation used in logging. Where it is necessary to liquidate expensive improvements, such as a logging railroad, it is essential to take a heavier cut and to plan on a longer cutting cycle than where truck logging is in use, with full advantage being taken of county and state highways for the hauling of logs.

ADVANTAGES AND DISADVANTAGES OF DIFFERENT CUTTING METHODS

In deciding upon the degree of cutting, there are many points to take into account. A consideration of the advantages and the disadvantages of each cutting method would, therefore, seem appropriate:

Heavy Cutting

Advantages:

1. The complete investment may be liquidated in one cut.

2. There will probably be a better mixture of species in the reproduction than under a light cutting. Heavy cutting tends to favor species that are intolerant of shade, such as the valuable yellow birch.

Disadvantages:

1. The growing stock is so depleted that the period of return for a second cut is greatly extended.

2. The residual stand may be of little value at the time of the second cut, owing to stem sprouting and decay caused by logging damage to the boles and tops.

3. Because the cutting cycle is very long there is no opportunity of improving the quality of the growing stock by frequent cuttings.

4. The fire hazard after cutting is great because of a heavy accumulation of slash and the absence of shade.

5. Recreational values are largely destroyed.

Light Cutting

Advantages:

1. The most overmature timber can be removed in the shortest possible time, which accelerates growth over the whole forest property at an earlier date than could be accomplished with a heavy cut.

2. Frequent cuts are possible, which permits opportunities for salvaging dead and defective trees.

3. A sufficient stand is left to warrant a second cut *at any time* in case of financial stringency. A heavy residual stand is, therefore, good insurance.

4. Growth in board feet is good, and, because it occurs on large trees, is of high value.

5. The fire hazard is kept to the minimum because slash is light, and the heavy residual stand prevents rapid drying out of the fuels.

6. There is relatively little damage to the residual stand by logging.

7. Recreational values are preserved.

Disadvantages:

1. Since the cutting is light it is possible to retire only a part of the investment in timber and improvements.

2. The cutting may be too light to accomplish removal of even the most decadent trees.

Moderate Cutting

Advantages:

1. Good silviculture may be practiced under this method since the cutting is heavy enough to insure removal of the unthrifty and diseased portion of the stand.

2. Growth in volume and quality is reasonably good.
3. A large part of the investment may be retired.
4. The fire hazard is not particularly high, although higher than in the light cutting.
5. Most of the recreational values are maintained.

Disadvantage:

The cutting cycle is fairly long, so that there is little opportunity to salvage losses.

CONCLUSION

On the basis of cutting experiments observed for ten years it has been shown that a selection type of cutting in which from one third to two thirds of the stand is removed in the first operation is well adapted to the northern hardwood forest. Such selection cuttings have resulted in good growth in volume of timber and in value of product. The increase in value has been at a higher rate than the growth in volume. Heavy cuttings of the "commercial" type, in which 90 per cent of the volume was removed, have been unsatisfactory.

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